Electrical (Illumination/Signals)

Construction Inspector's Training Manual

January 2005

Washington State
Department of Transportation

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Washington State Department of Transportation
Environmental and Engineering Programs
Construction Office

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Part 1

Introduction

Importance of System

Provide safety on new system (freeway illumination)

Improve safety of existing intersection

Reduce traffic conflict at hazard location

Importance of Inspection

Industry standard work methods are followed

Required by RCW 19.28.10 (see Appendix E)

Materials used on the job are approved

Materials are installed in the right location

Materials are installed according to the plans

Materials used for proper application

Course Objectives

Upon completion of this course, participants will be able to:

1. Understand the illumination and signal system functions.
2. Read and interpret illumination and signal plans.
3. Investigate lighting and signal foundation locations.
4. Conduct inspection and sampling of conduits, wire, and other materials.
5. Detect unworkmanlike procedures.
6. Conceptualize the total function and purpose of the illumination and signal system.

3:P65:DP/E(IS)

Part 2

Document Review

Documents

1. Addenda
2. Proposal Form
3. Special Provisions
4. Contract Plans
5. Amendments to the *Standard Specifications*
6. *Standard Specifications*
7. *Standard Plans*
8. *Construction Manual*
9. National and State Electrical Codes
10. Utility Agreement

Contacts

Regional Construction Trainer

Regional Electrical Inspector

Maintenance/Signal Division/ITS

Regional Traffic Engineer

Fabrication Inspector

Headquarters Bridge and Materials Laboratory

Serving Utility, Vendors, Manufacturer's Representatives, and Utility Engineer in Region

Documents for Materials Approval

The Contractor shall submit to the Engineer a completed "Request for Approval of Material" or page from the Qualified Products List promptly following execution of contract:

Review Record of Materials

Review RAM and Qualified Products List (QPL)

Catalog Cuts

Shop Drawings

Wiring Diagrams

Light and Signal Standard Drawings

Metal Strain Pole Drawings

Review any Items to be Salvaged, Abandoned, or as Ordered by the Engineer

Materials Basics

Contractor	Must notify engineer of all proposed materials Get approval from engineer Use new material unless special provisions permit otherwise
Engineer	May inspect or test material at any time Shall reject material if they become unfit Shall document material approval and acceptance

Materials approval

"ROM" Record of Materials - Is developed by headquarters materials laboratory and your PE office is to keep it current.
It will contain all permanent products used in the contract.
More than one item can be submitted for the same application and it is up to you to know what was used or not used for each application. Sometimes the contractor forgets to write all the bid item applications for a materials use.

Example

Contractor submits three brands of conductors for use on the project. Two are approved and one is not.

At the end of the job, there are samples of only one kind of conductor, what happened to the other two?

RECORD OF MATERIALS

Bid Item	Quantity	Unit	Description	Documentation Req'd	Spec. Ref.
6	1	LUMP SUM	TRAFFIC SIGNAL SYSTEM NO.1		9-29
6.01			2" GRS CONDUIT	SAMPLE VERIFICATION OF UL LABEL	9-29.1
6.02			2" GRS COUPLER	SAMPLE CATALOG CUTS/VERIFY	9-29.1
6.03			2" GRS GROUNDING END BUSHING	SAMPLE CATALOG CUTS/VERIFY	9-29.1
6.04			COLLIDAL COPPER	CATALOG CUTS/VERIFY	9-29.1
6.05			JUNCTION BOX TYPE 1	CATALOG CUTS	9-29.2(1)
6.06			JUNCTION BOX TYPE 2	CATALOG CUTS	9-29.2(1)

Reviewed by PE Office for Accuracy and Amended if Necessary

7/29/2004 14

"QPL" Qualified Products List – published annually and can be found on the Internet. The contractor identifies materials he will use by submitting the appropriate QPL page. One item per page shall be submitted. The most current QPL page must be submitted at the time the product is proposed for use.

Check the special provisions to ensure the products meet the contract. Look up approval codes and check the notes. It is up to you to verify the product is approved for the intended application. You are the only one who knows the use of the product submitted.

For QPL "A" approved items you will still need to field verify the material received and used is that submitted. Retain labels, bill of lading, delivery tickets, etc…….. Write in the IDR where and how much of that material was used. Reference the QPL to show you have the necessary documentation for that material.

For QPL "CA" conditionally approved materials, verify the proper documentation in your IDR. Take tests or samples if required.

"QPL"

Washington State Department of Transportation

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
QUALIFIED PRODUCTS LIST

January 25, 2002

Contractor : ABC Construction **Contract Number :** 9999

Sub Contractor : **Date :** 12-24-02

Specification Reference - Material Category	Reference No	Accept. Code	Last Update

9-16.2(2) Wire Fence - Steel Fence Posts and Braces: Pull Posts

Oregon Rolling Mills - Portland, OR

End, Corner, Pull, & Gate Posts for Wire Fence

Bid Item # 66 *Qty* _____ *Verified By* _____ *Date* _____

GFI 1993-321 CA 1020 10/15/1994

End, Corner, Pull, or Gate Post for wire fence Type 1 or 2.

See Notes: (2)

9-16.2(6) Wire Fence - Barbed Wire

Davis Wire Corp. - Kent, WA

Bid Item # _____ *Qty* _____ *Verified By* _____ *Date* _____

BARBED WIRE FOR WIRE FENCE

GFI 1993-270 CA 1020 10/15/1994

Barbed Wire shall be 12.5 gage wire, twisted four point barbs spaced 5 Inches (125mm). Meets AASHTO M 280. Galvanizing shall be Class 3.

APPENDIX - A

Acceptance Codes

January 24, 2002

CODE	Acceptance Criteria
1010	Receipt of a satisfactory Test Report from WSDOT Materials Lab indicating that the lot (or lots) of material meets the requirements of the specifications under which it is listed.
1015	Receipt of a satisfactory Test Report from WSDOT Materials Lab indicating that the lot (or lots) of material meets the requirements of the specifications under which it is listed. Submit Manufacturer's Certificate of Compliance along with the sample.
1020	Receipt of a satisfactory Test Report from WSDOT Materials Lab indicating that the lot (or lots) of material meets the requirements of the specifications under which it is listed. Request 'Certificate of Material Origin' from the manufacturer when Contract Documents include 'Foreign Made Materials' clause.

9-14 - Erosion Control and Roadside Plantings

Note 1 Verify that the fertilizer formulation as stated in the Manufacturer's Certification is the same as the formulation specified in the Contract's Special Provisions. Pay particular attention to the percentage of nitrogen derived from either isobutylidene diurea (IBDU), cyclo-di-urea (CDU), or sulfa coated urea (SCU).

Note 2 Retain a tag from a bag showing content analysis.

9-16 - Fence and Guard Rail

Note 1 Posts for Chain Link Fence shall be of the size and weight listed in Std. Plan L-2 (sheet 2 of 2) and meet the specifications of Std. Spec 9-16.1(1) and 9-16.1(2).

Note 2 Line Post for wire fence shall be at least 7 feet (2.13 m) and minimum weight of 1.33 pounds per L.F. (1.98 kg/m) and meet the requirements of Std. Spec. 9-16.2(2).

Note 3 The use of this material is restricted to East of the Cascades. If a Manufacturer's Certificate is not present or does not identify the min. yeild strength, exterior surface zinc coating and interior zinc coating then the post shall be tested to Class 1 specifications prior to use.

"RAM" Request for Approval of Material – required if "QPL" is not used. Will be submitted by the contractor to the PE office. The PE office approves or forwards to headquarters. (***Remember that approval does not constitute acceptance.)*** The inspector must field verify all material and document the use and acceptance in the IDR.

This is where you get sub item numbers on the ROM

Contract	FA Number	SR	Date
4928	STPF-0014(028)	14	10-10-98
Section: Stevenson Two-Way Couplet		County: Skamania	
Contractor: Scoccolo Construction	Subcontractor: Blessing Electric		

For assistance in completing, see Instructions and Example

RAM # 42

Bid Item No.	Material or Manufacturer's Product/Type	Name of Manufacturer/Fabricator or Pit Number	Specification Reference	PE Appr'l Code	OSC Appr'l Code	File No.
116.14	Electrical Service Cabinet with Componets	Skyline Electric & Mfg. Co.	9-29.24	3		E-120
116.24	Luminaire Poles 30'	Valmont Industries	9-29.6	5		E-143
116.28	Steel Rebar	Far West Steel	9-07.6	2		ST-074
		Nucor Steel		2, 6		ST-073
		Birmingham Steel		2, 6		ST-209
116.29	1" Anchor Bolts	Portland Bolt	9-29.6(5)	5		St-054
116.31	Luminaires & Lamps	American Electric Series 325	9-29.10	1		E-126

WSDOT USE

Project Engineer: Daniel Cotton — Date: 10-15-98 — OSC Materials Engineer — Date

Approval Action Codes for use by Project Engineer and OSC Materials Laboratory

1. Conditionally Approved: Acceptance based upon 'Satisfactory' Test Report for samples of materials to be incorporated into project.
2. Conditionally Approved: Submit Mfg. Cert. of Compliance for 'Approval' prior to use of material.
3. Conditionally Approved: Submit Catalog Cuts for 'Approval' prior to use of material.
4. Conditionally Approved: Submit Shop Drawings for 'Approval' prior to fabrication of material.
5. Conditionally Approved: Only 'Approved for Shipment' or 'WSDOT Inspected' material *shall* be used.
6. Conditionally Approved: Submit Materials Certificate of Origin to Project Engineer.
7. Approval Pending: Request Transmitted to OSC Materials Laboratory for Approval Action.
8. Source Approved:
9. Approval Withheld: Submit samples for preliminary evaluation.
10. Approval Withheld:
11.

Remarks:

Materials Tracking "Ram"

					CONTRACT 4928					
					Steveson 2-Way Couplet					
Item No.	**Plan Qty**	**Unit**	**Description**	**Std. Spec**	**Manufacturer/ Product Identification**	**RAM No. QPL**	**Appv code**		**RAM/ QPL Status**	**Remarks**
			Approval Codes							
			1. Sample Required 2. Mfg. Cert. of Compliance 3. Catalog Cut 4. Shop Drawings 5. Fabrication Inspection Req'd 6. Cert. 100% American Made 7. Pending 8. Approved							
17.01	18020	C.Y.	GRAVEL BORROW INCL. HAUL	9-03.14	K. W. Peterson SA-48	1	1		Conditionally approved	Satisfactory Test Report
18.01	35630	C.Y.	EMBANKMENT COMPACTION	SPEC.PROV.						
19.01	419	L.F.	ASPHALT CONC. GUTTER	8-04.3(2)					Need	
20.01	3	C.Y.	HAND PLACED RIPRAP	9-13.2	K. W. Peterson SA-48	1	8		approved	Field Acceptance, Verification of Source
21.01	9	C.Y.	QUARRY SPALLS	9-13.6	K. W. Peterson SA-48	1	8		approved	Field Acceptance, Verification of Source

Tracking of the Materials Needs to be Maintained Throughout the Project.

Catalog cut sheets

Another way of approving material. Usually contains a picture of the item, instructions for use and/or installation, based on the manufacturers recommendations. Again, be sure the material submitted meets the contract; check the special provisions to ensure the correct product has been submitted for use. Very useful when your not familiar with a product.

Catalog Cut

Just another way of Approving Materials

TRANSMITTAL OF CATALOG CUTS

DATE: 2/4/99 CONTRACT: 005523 SR-5

FROM: J. McClellan N.E. 179th Street Interchange

TO: FIELD OPERATIONS SUPPORT SERVICE CENTER-DOCUMENTATION SECTION; MS47365

Bid Item Number	Material Description	Manufacturer	FOSSC USE ONLY FOSSC Appr'l Action
57.108	Pedestrain Push button assembly	McCain Traffic Supply	Approved

INSTRUCTIONS:

1.) This form is the "MASTER" and will need to be copied and used throughout the contract for each catalog cut submitted for approval.

2.) The Project Office will fill in the "DATE","Bid Item Number","Material Description","Manufacturer". If the Project Office is unable to provide this information, request the additional information from the Contractor.

3.) Attach ONE (1) copy of the catalog cut for retention at the FOSSC- M

4.) FOSSC will check the catalog cut for compliance with the appropriate section of the standard specification, mark the" FOSSC Appr'l Action" and return this Transmittal Cover Sheet to the Project Engineer.

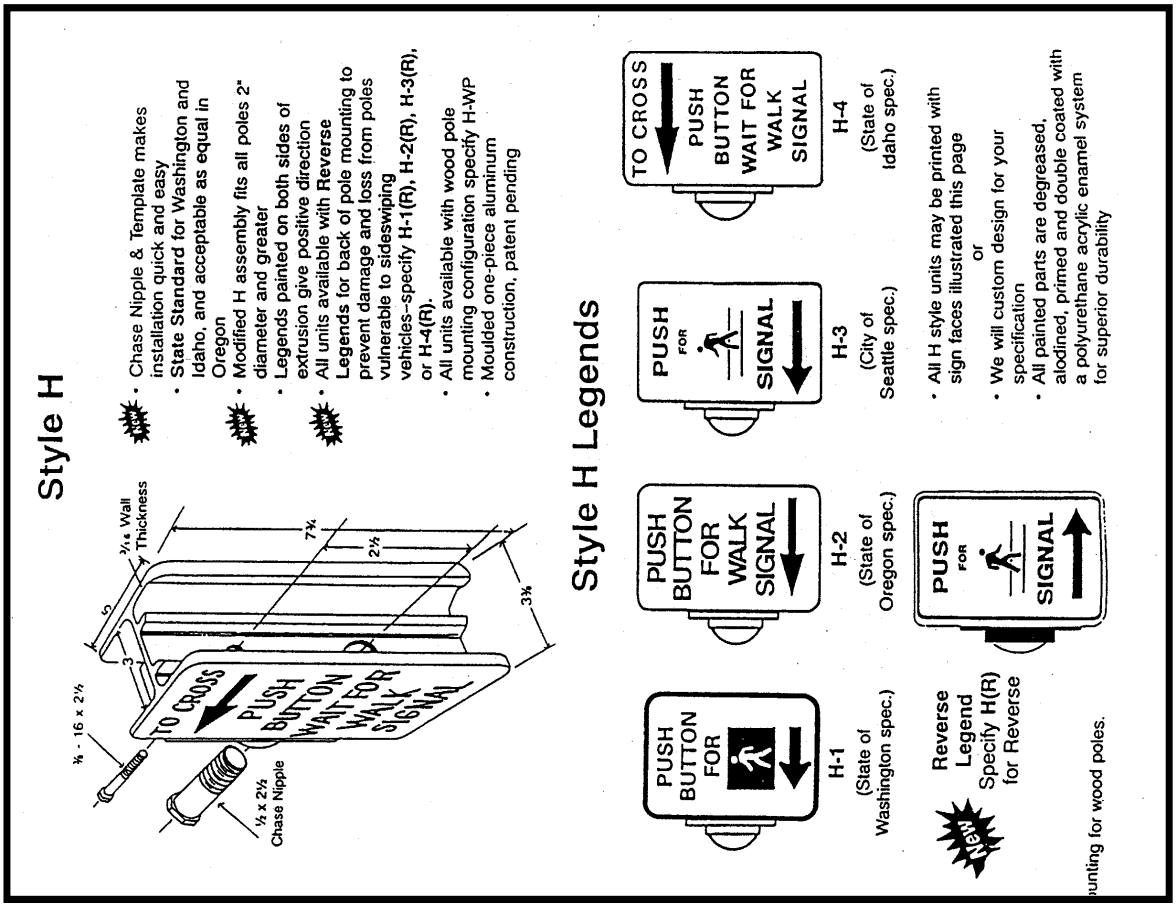
REMARKS:

McClellan
Mitchell
Schultz
Henderson
Hill
File

APR 0 9 1999

APPROVED
APR - 5 1999
D.C. JACKSON P.E., MATLS. ENGR.
BY:

DISTRIBUTION:
Mat'l File x
J Engr x


Style H
• Chase Nipple & Template makes installation quick and easy
• State Standard for Washington and Idaho, and acceptable as equal in Oregon
• Modified H assembly fits all poles 2" diameter and greater
• Legends painted on both sides of extrusion give positive direction
• All units available with Reverse Legends for back of pole mounting to prevent damage and loss from poles vulnerable to sideswiping vehicles--specify H-1(R), H-2(R), H-3(R), or H-4(R).
• All units available with wood pole mounting configuration specify H-WP
• Moulded one-piece aluminum construction, patent pending
¼ x 16 x 2½
¼ Wall Thickness
½ x 2½ Chase Nipple
TO CROSS PUSH BUTTON WAIT FOR WALK SIGNAL
7¾
2½
3¾
Style H Legends
PUSH BUTTON FOR
H-1
(State of Washington spec.)
PUSH BUTTON FOR WALK SIGNAL
H-2
(State of Oregon spec.)
PUSH FOR SIGNAL
H-3
(City of Seattle spec.)
TO CROSS PUSH BUTTON WAIT FOR WALK SIGNAL
H-4
(State of Idaho spec.)
Reverse Legend
Specify H(R) for Reverse
NEW
PUSH FOR SIGNAL
• All H style units may be printed with sign faces illustrated this page
or
• We will custom design for your specification
• All painted parts are degreased, alodined, primed and double coated with a polyurethane acrylic enamel system for superior durability
unting for wood poles.

Catalog Cut

Responsibilities

Project Engineer

Check “ROM” for items requiring off site Inspection
Notify fabrication inspection office of off site materials
Ensure the “QPL” or “RAM” is submitted in a timely manner
Get shop drawings in early for review and approval
Mark drawings in green for corrections to be made that don’t meet the contract requirements
Check geometrics, ped poles, pre-approved signal standards, foundation locations, H-1 dimensions, mast arm lengths, orientation, signal head offsets, vertical clearances, signal head mounting connections, hand hole locations and orientation, slip or fixed base requirements.

Bridge Office

Check luminaires not listed in “QPL”
Isocandela diagrams
Light socket positions
Signal standards type II, III, IV, V with or without pre-approval
All signal poles and sign bridges
Any special designs or modifications

Sampling

Check the construction manual for frequency, methods, and quantities of samples to be taken. The RAM or QPL will tell you if it needs a sample (when in doubt get one). Be sure the sample is representative of what is being used. No damage!

Materials Acceptance

Documentation

It is through complete record keeping that the **Engineer** will determine;
Quality and acceptability of materials
Quantities to be paid for
Existence of any “Change of Conditions”
Unworkable days or suspension of work
Fulfillment of the contract

"IDR" Inspectors daily report – Should provide a complete word picture of the project progress. Use the five C's, clear, concise, correct, complete, & concurrent. For listing quantities used and locations placed. List the manufacturer, type, size, slip or fixed bases, type of stamps or acceptance you used to allow installation, and condition.

Photo Log Before and after pictures for each operation of work performed can be an important part of evidence for claims review. They can identify products as well as stamps used for acceptance.

Inspected Items

Items that are inspected and found acceptable by a WSDOT materials fabrication inspector are identified by a Tag or Stamp

Electricians

Persons performing the work shall submit to the engineer, proof of certification, in accordance with RCW 19.28.161 prior to performing any work.

An electrician must be in control of all work performed, whether by apprentice or sub contractor.

Layout and Staking

Review the plans

Figured dimensions take precedence over scaled dimensions

Thorough location investigation above and below ground (to be done after utilities locate completed) — pot holing may be required

Does the final location serve desired purpose?

Measure distance from foundation to lane edge — layout channelization

Measure overhead clearances — check with owner

Measure what mast arm length will be — check shop drawings

Do not move luminaire foundation location without discussing with PE

Junction box location within 10 feet of poles

Junction boxes not allowed in traveled roadway or bottom of ditch

Review all location conflicts with regional signal maintenance staff

Move small signs to luminaire poles

Install plastic J-Box markings

Part 3

Plan Reading

General Items for All Electrical Plans

A very important thing to do when reading all plan sheets is to become familiar with the Legend. This is the key to what is what on the sheets you are looking at. As the inspector, it is recommended that you trace each size of the conduit run with different colored highlighters. This makes it easier to follow a run from start to finish. To make it easier to view and to have more room for as-built notes, it is recommended that you get a set of full size plans and then make copies of sections on 11 by 17 inch paper of areas needed.

Become as familiar as possible with the contract plans, specials, and standard plans before construction begins. Preparation will save you lots of headaches later in the project.

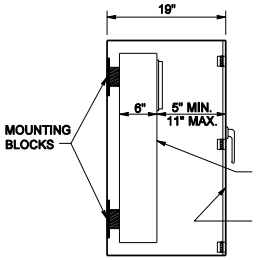
Illumination Plans

Illumination Plans are usually very basic when they are on a separate plan sheet. You can look at sheet IL-1 (sheet 246) in the hand out plans as an example. You will notice that there is a detail for the power service and cabinet location on this sheet. This sheet has three luminaires and three conduit runs on it.

GENERAL NOTES

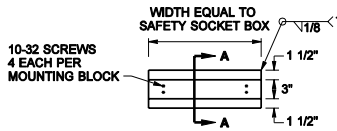
200 AMP TYPE 120/240 1ø SERVICE CABINET

1. SEE STANDARD SPECIFICATION 9-29.24, SERVICE CABINETS.
2. HINGES SHALL HAVE STAINLESS STEEL OR BRASS PINS.
3. CABINETS SHALL BE RATED NEMA 3R AND SHALL INCLUDE TWO RAIN TIGHT VENTS.
4. METERING EQUIPMENT DOOR SHALL BE PAD LOCKABLE. EACH DOOR SHALL BE GASKETED. INSTALL BEST CX CONSTRUCTION CORE ON RIGHT DOOR. SEE DOOR HINGE DETAIL, SHEET 1 OF 2.
5. THE FOLLOWING EQUIPMENT WITHIN THE SERVICE ENCLOSURE SHALL HAVE AN APPROPRIATELY ENGRAVED PHENOLIC NAME PLATE ATTACHED WITH SCREWS OR RIVETS: KEY NUMBERS 2, 3, 4, 6, 7, 8, 9 AND 16. KEY NUMBER 4 NAME PLATE SHALL READ: "PHOTOCELL BYPASS TEST ON" AND "PHOTOCELL TEST OFF- AUTOMATIC". SEE SERVICE CABINET DETAIL.
6. METERING ARRANGEMENTS VARY WITH DIFFERENT SERVING UTILITIES. THE UTILITY MAY REQUIRE METER BASE MOUNTING IN THE ENCLOSURE, ON THE SIDE OR ON THE BACK OF THE ENCLOSURE. THE UTILITY MAY REQUIRE THE DIMENSION BETWEEN THE DOOR AND THE FRONT OF THE SAFETY SOCKET BOX TO BE LESS THAN THE 11 INCHES SHOWN IN THE LEFT SIDE- SAFETY SOCKET BOX MOUNTING DETAIL. THE CONTRACTOR SHALL VERIFY THE SERVING UTILITY'S REQUIREMENTS PRIOR TO FABRICATION OF AND INSTALLING THE SERVICE EQUIPMENT.
7. DIMENSIONS SHOWN ARE MINIMUM AND SHALL BE ADJUSTED TO ACCOMMODATE THE VARIOUS SIZES OF EQUIPMENT INSTALLED.
8. ALL BUSSWORK SHALL BE HIGH GRADE COPPER AND SHALL EQUAL OR EXCEED THE MAIN BREAKER RATING. ALL BREAKERS SHALL BOLT ONTO THE BUSSWORK. JUMPERING OF BREAKERS SHALL NOT BE ALLOWED. BUSSWORK SHALL ACCOMMODATE ALL FUTURE EQUIPMENT AS SHOWN IN THE BREAKER SCHEDULE.
9. THE PHOTOCELL UNIT SHALL BE CENTERED IN THE PHOTOCELL ENCLOSURE TO PERMIT 360 DEGREE ROTATION OF THE PHOTOCELL WITHOUT REMOVAL OF THE PHOTOCELL UNIT OR THE PHOTOCELL ENCLOSURE.
10. ALL INTERNAL WIRE RUNS SHALL BE IDENTIFIED WITH "TO - FROM" CODED TAGS LABELED WITH THE CODE LETTERS AND/OR NUMBERS SHOWN ON THE SCHEDULES. APPROVED PVC OR POLYOLEFIN WIRE MARKING SLEEVES SHALL BE USED.
11. ALL NUTS, BOLTS AND WASHERS USED FOR MOUNTING THE PHOTOCELL ENCLOSURE SHALL BE STAINLESS STEEL.
12. A 1% TOLERANCE IS ALLOWED FOR ALL DIMENSIONS.
13. UNISTRUT OR EQUIVALENT CHANNEL AND MOUNTING HARDWARE COMPONENTS SHALL BE STAINLESS STEEL. CONDUIT CLAMPS SHALL BE HOT DIPPED, GALVANIZED STEEL OR STAINLESS STEEL.
14. INSTALL CONDUIT COUPLINGS ON ALL CONDUITS. PLACE COUPLINGS FLUSH WITH TOP OF CONCRETE FOUNDATION.
15. NOTE 15 HAS BEEN DELETED.
16. THE METER BASE PORTION OF THIS SERVICE WAS DESIGNED TO MEET METERING PORTION OF EUSERC DRAWING 309 REQUIREMENTS.
17. WHEN USING ALTERNATE DOOR HINGE: REMOVE HINGE PIN PRIOR TO WELDING HINGE TO CABINET AND PRIOR TO HOT DIP GALVANIZING CABINET. AFTER GALVANIZING, REPLACE PIN WITH BRASS PIN AND SOLDER IN PLACE.



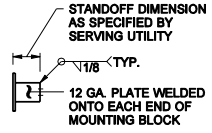
LEFT SIDE- SAFETY SOCKET BOX MOUNTING DETAIL

FABRICATE MOUNTING BLOCKS AFTER VERIFYING THE SERVICE UTILITY STAND OFF DIMENSION.

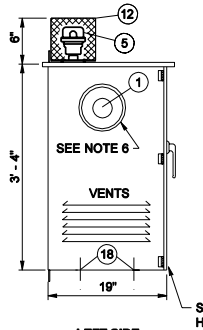


MOUNTING BLOCK DETAIL

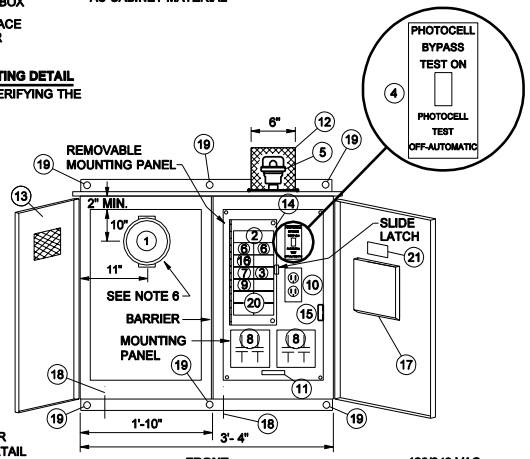
12 GA. - MATERIAL TO BE SAME AS CABINET MATERIAL



SECTION A-A

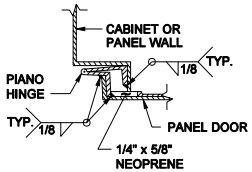


LEFT SIDE

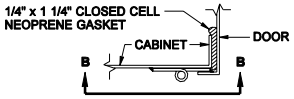


FRONT

SERVICE CABINET DETAIL

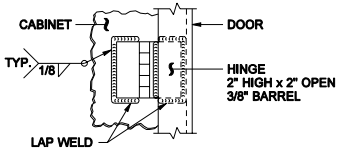


DOOR HINGE DETAIL

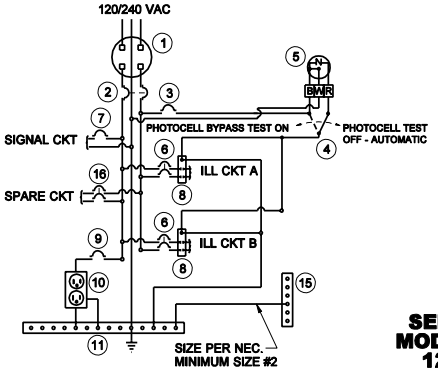


DOOR HINGE DETAIL

ALTERNATE FOR TYPE B MODIFIED CABINET SEE NOTE 17



VIEW B-B



WIRING SCHEMATIC

KEY

1. METER BASE PER SERVING UTILITY REQUIREMENTS. AS A MINIMUM, THE METER BASE SHALL BE SAFETY SOCKET BOX WITH FACTORY INSTALLED TEST BYPASS FACILITY THAT MEETS THE REQUIREMENTS OF EUSERC DRAWING 305.
2. MAIN BREAKER (SEE BREAKER SCHEDULE)
3. PHOTOCELL BREAKER (SPST 15 AMP - 120/240 VOLT)
4. TEST SWITCH (SPDT SNAP ACTION, POSITIVE CLOSE 15 AMP - 120/277 VOLT - "T" RATED)
5. PHOTOELECTRIC CONTROL, STD. SPEC. 9 - 29.11(2)
6. BRANCH BREAKER (SEE BREAKER SCHEDULE)
7. SIGNAL BREAKER (SEE BREAKER SCHEDULE)
8. CONTACTOR (SEE BREAKER SCHEDULE)
9. RECEPTACLE BREAKER (SPST 20 AMP - 120/240 VOLT)
10. RECEPTACLE, GROUNDED (GFCI 20 AMP - 125 VOLT)
11. NEUTRAL BUSS, 14 LUG COPPER
12. PHOTOCELL ENCLOSURE - ENCLOSURE TO BE FABRICATED FROM 5/8" EXPANDED STEEL MESH WITH WELDED SEAMS AND MOUNTING FLANGES. HOT DIP GALVANIZED AFTER FABRICATION. TYPE 5052 - H32 ALUMINUM WITH 5/8" x 5/8" OPENINGS EQUIVALENT TO 5/8" EXPANDED STEEL MESH MAY BE USED AS ALTERNATIVE MATERIAL. SEE PHOTOCELL ENCLOSURE MOUNTING DETAIL, SHEET 2 OF 2.
13. HINGED FRONT FACING DOOR WITH 4" x 4" MIN. POLISHED WIRE GLASS WINDOW.
14. HINGED DEAD FRONT WITH 1/4 TURN FASTENERS OR SLIDE LATCH.
15. CABINET MAIN BONDING JUMPER. BUSS SHALL BE 4 LUG TINNED COPPER. SEE CABINET MAIN BONDING JUMPER DETAIL ON SHEET 2 OF 2.
16. SPARE BRANCH BREAKER (DPST 20AMP- 120/240 VOLT)
17. METAL WIRING DIAGRAM HOLDER
18. 1/4" DIAMETER DRAIN HOLE. DRILL BEFORE GALVANIZING.
19. MOUNTING HOLE. SEE SERVICE CABINET MOUNTING DETAILS.
20. 18 CIRCUIT PANEL BOARD - MINIMUM SIZE WITH SEPARATE MAIN BREAKE
21. LABEL CABINET WITH BUSSWORK RATING.

R. SCOTT ZELLER
STATE OF WASHINGTON
28680
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES MAY 5, 2003

SERVICE CABINET TYPE B MODIFIED (0 - 200 AMP TYPE 120/240 SINGLE PHASE) STANDARD PLAN J-3b

SHEET 1 OF 2 SHEETS

APPROVED FOR PUBLICATION

Harold J. Peterfeso — STATE DESIGN ENGINEER — *06-24-02* DATE

Washington State Department of Transportation

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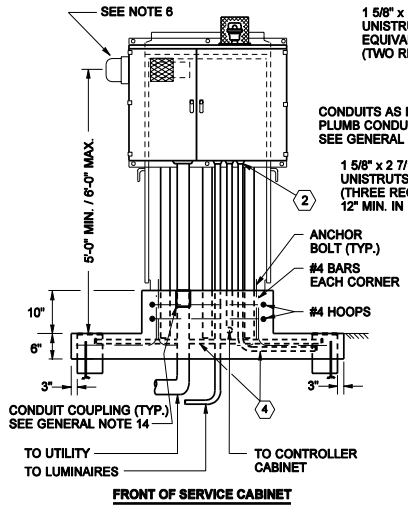
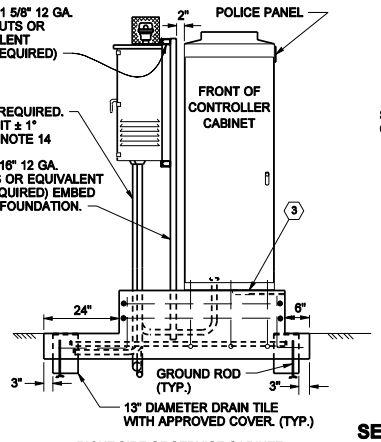
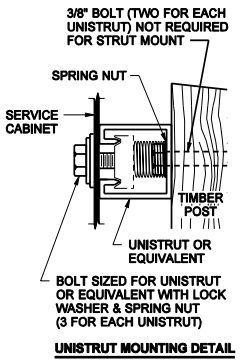


FRONT OF SERVICE CABINET

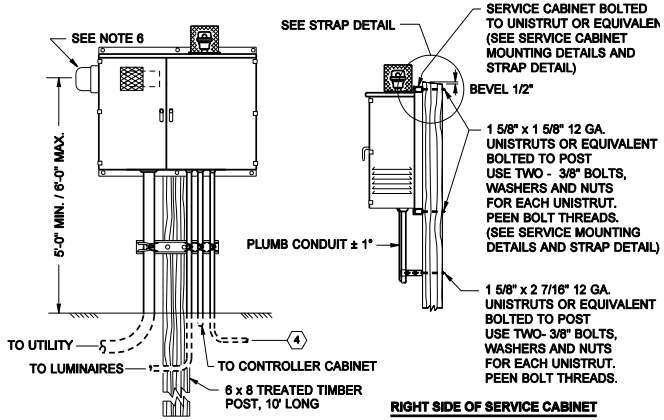


RIGHT SIDE OF SERVICE CABINET



UNISTRUT MOUNTING DETAIL

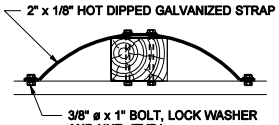
SERVICE CABINET MOUNTING DETAILS



FRONT OF SERVICE CABINET

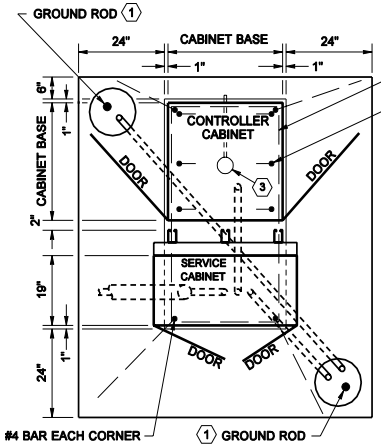
RIGHT SIDE OF SERVICE CABINET

POST MOUNT



POST MOUNT STRAP DETAIL

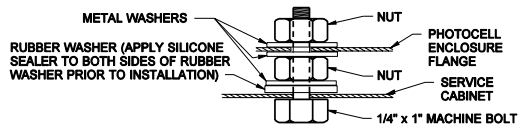
STRUT MOUNT



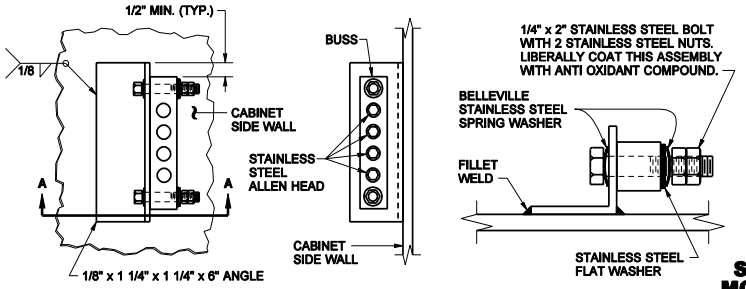
PLAN VIEW OF SERVICE CABINET

SEE STANDARD PLAN J-6c "CABINET FOUNDATION DETAILS", FOR DETAILS NOT SHOWN.

1. DRIVE GROUND RODS BEFORE PLACING CONCRETE. MOVE ROD(S) AND DRAIN TILE(S) WITH COVER(S) AS REQUIRED TO ACHIEVE FULL GROUND PENETRATION. MAINTAIN A 6' MINIMUM CLEARANCE BETWEEN GROUND RODS AS DETAILED ON STD. PLAN J-9a "TYPICAL GROUNDING DETAILS".
2. ALL CONDUITS PENETRATING CABINET SHALL BE TERMINATED WITH GROUNDING END BUSHING AND BONDED TO THE CABINET GROUNDING BUS.
3. 4" DIAM. x 1/2" DEEP SUMP. SLOPE FOUNDATION TOWARDS SUMP. 3/8" DIAM. POLYETHYLENE OR COPPER DRAIN PIPE. SLOPE TO DRAIN OUTSIDE FOUNDATION.
4. TO SERVICE GROUND - PER STD. PLAN J-9a "TYPICAL GROUNDING DETAILS"



PHOTOCELL ENCLOSURE MOUNTING DETAIL



ELEVATION VIEW

SIDE VIEW

DETAIL A-A

CABINET MAIN BONDING JUMPER DETAIL

R. SCOTT ZELLER
STATE OF WASHINGTON
28680
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES MAY 5, 2003

SERVICE CABINET TYPE B MODIFIED (0 - 200 AMP TYP 120/240 SINGLE PHASE) STANDARD PLAN J-3b

SHEET 2 OF 2 SHEETS

APPROVED FOR PUBLICATION

Harold J. Peterfeso 06-24-02

STATE DESIGN ENGINEER — DATE

Washington State Department of Transportation

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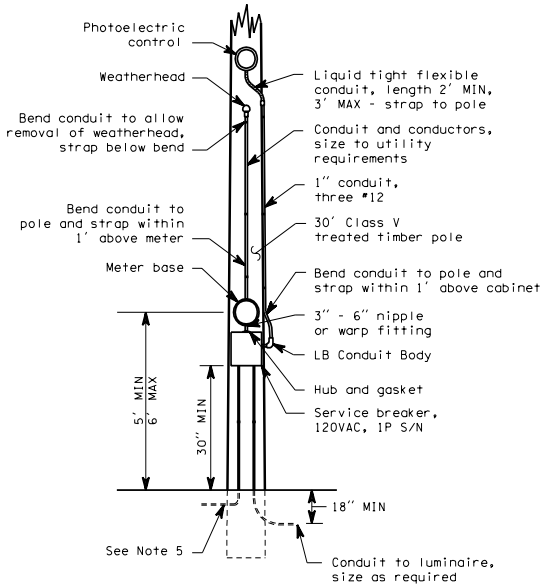
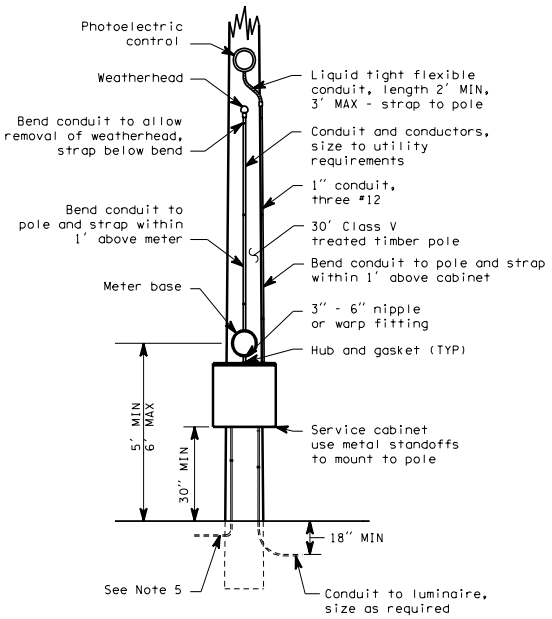
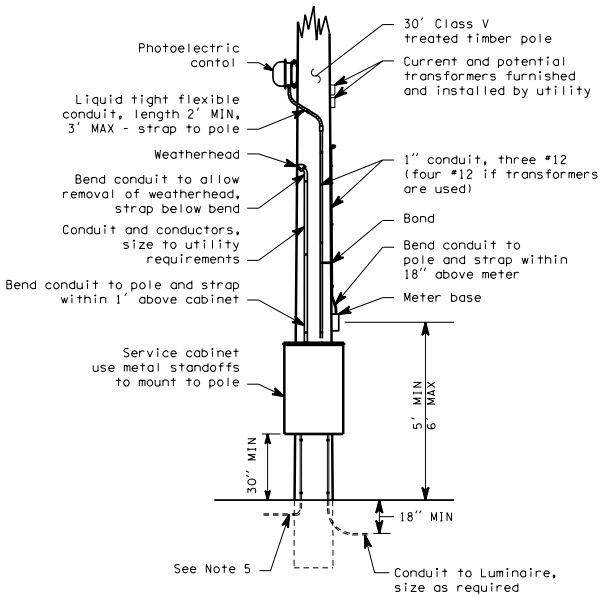


TYPE A SERVICE, 120 VOLT

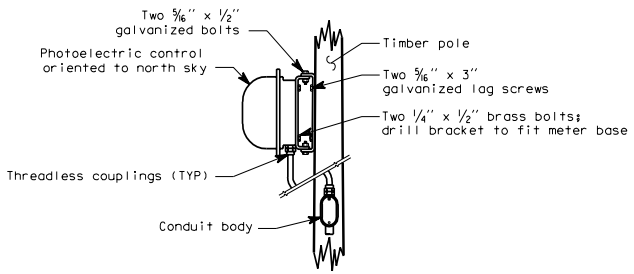


TYPE B SERVICE, 120/240 VOLT



TYPE C SERVICE, 480 VOLT

TYPE A, B AND C SERVICE LIGHTING DETAILS



PHOTOELECTRIC CONTROL DETAILS

STANDARD PLAN J-3

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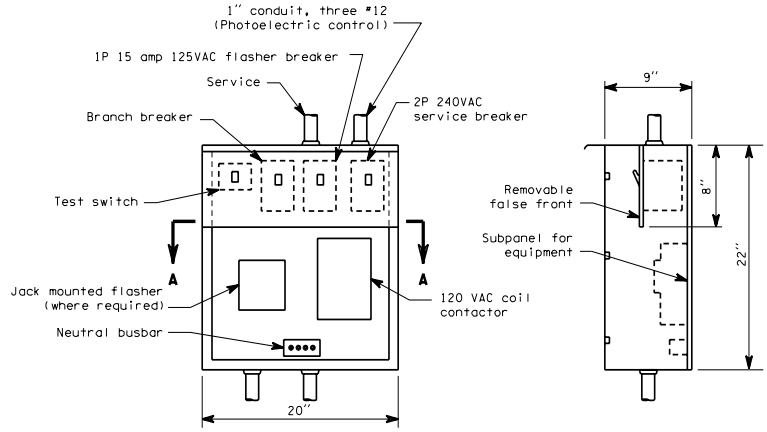
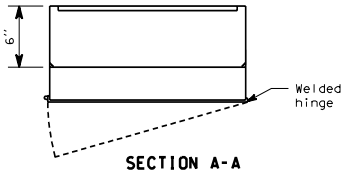
STATE DESIGN ENGINEER — DATE

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON

Sheet 1 of 2 Sheets



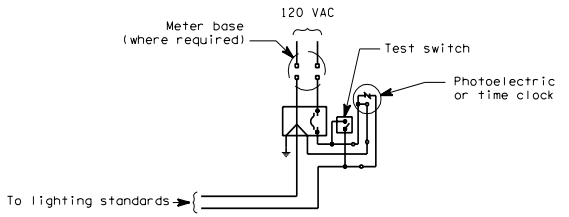
TYPE B SERVICE CABINET



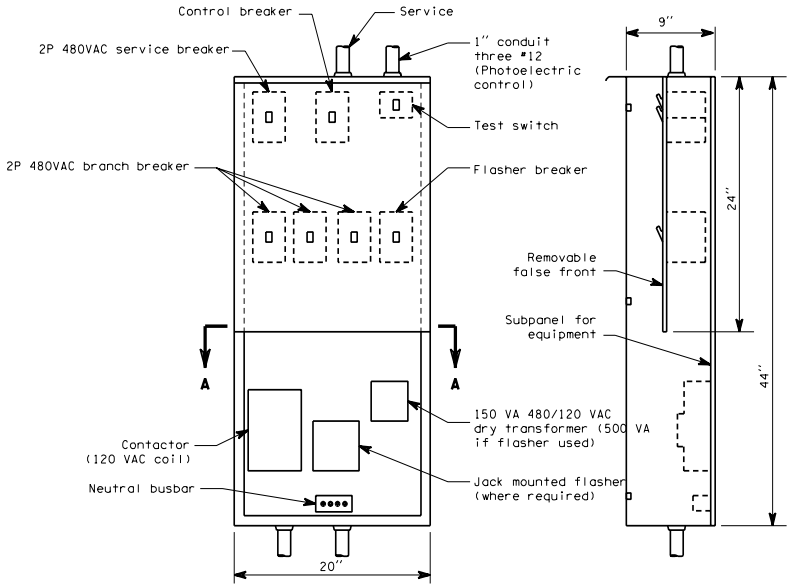
SECTION A-A

NOTES:

1. Metering arrangements may vary with different serving utilities. The contractor shall verify the requirements of the utility prior to installing the service equipment.
2. All service pole conduit shall be secured to the pole with conduit strap at 5' centers.
3. All risers and service equipment shall be installed on side of pole that is away from traffic.
4. Where required by the serving utility, service breakers shall be installed above the meter socket in a separate raintight enclosure.
5. Bend and attach to pole within 1' of enclosure. See Standard Plan "Typical Grounding Details."
6. For Type B service wiring diagram, use Standard Plan "Modified Type B Service". For Type C service wiring diagram, use Standard Plan, "Type E Service."
7. See breaker schedule in contract for breaker and contactor sizes.



TYPE A WIRING DIAGRAM
120 VOLT



TYPE C SERVICE CABINET

TYPE A, B AND C SERVICE LIGHTING DETAILS

STANDARD PLAN J-3

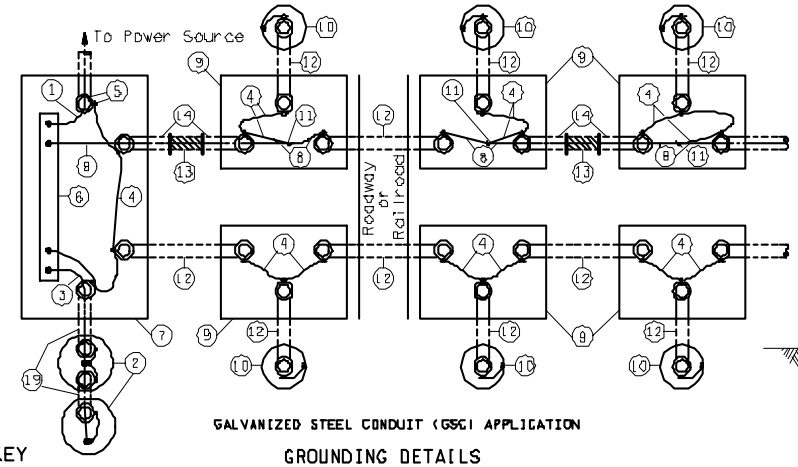
APPROVED FOR PUBLICATION

STATE DESIGN ENGINEER DATE

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON

Sheet 2 of 2 Sheets

COMBINATION GALVANIZED STEEL CONDUIT (GSC)
AND NON-METALLIC CONDUIT (NMC) APPLICATION



GALVANIZED STEEL CONDUIT (GSC) APPLICATION

KEY

1. Service Neutral
2. Service Ground
3. Grounding Electrode Conductor
4. Bonding Jumper
5. Grounding Bushing (typ. all conduit terminations)
6. Service Neutral Bus (Copper)
7. Service Enclosure
8. Equipment Grounding Conductor
9. Junction Box
10. Electrical Load Support (luminaire pole)
11. Copper Split Bolt Clamp
12. Galvanized Steel Conduit (GSC)
13. Non-metallic Conduit (NMC)
14. Option A - 10' GSC with Field Bend
    - Approved Adapter Fitting
    - Grounding Bushing

    Option B - 10' GSC
    - GS Factory Elbows
    - Approved Adapter Fitting
    - GS Coupling
    - Grounding Bushing
15. Ground Rod
16. Edge of Foundation, Pole or Service Support
17. Clamp
18. Junction Box or 8" Drain Tile with Approved Cover
19. Code Sized GSC
20. To Service Neutral Bus
21. To Grounding Terminal or Connection to Equipment Grounding System

GROUNDING DETAILS

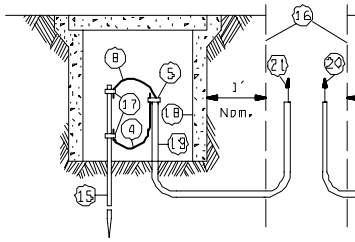
NOTES

1. If parallel circuits of different sizes are contained in one conduit, the size of the grounding conductor shall be determined on the basis of the largest conductor. Only one grounding conductor is required for each conduit regardless of the number of circuits contained.

2. Service ground per serving utility requirement. If the utility uses aluminum service conductors, an approved Al-Cu pressure type ground connector shall be used to secure the service neutral to the copper neutral bar in the service enclosure. Except for the above, all grounding conductors shall be copper.

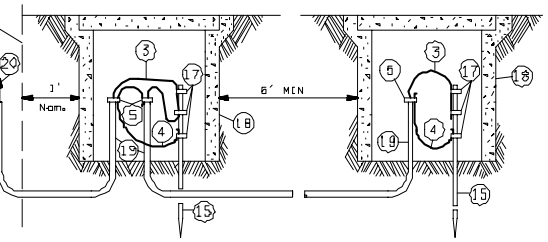
3. Equipment grounding conductors and grounding electrode conductors shall be sized in accordance with the National Electric Code (No. 8 minimum) .

SUPPLEMENTAL GROUND



Required to supplement equipment grounding for luminaire standards with direct burial, aerial feeds, or where required in plans.

SERVICE GROUND



Required at all services and separately derived systems.

GROUND ROD DETAILS

DAVID K. PEACH
STATE OF WASHINGTON
21808
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES JUNE 4, 1999

TYPICAL GROUNDING DETAILS

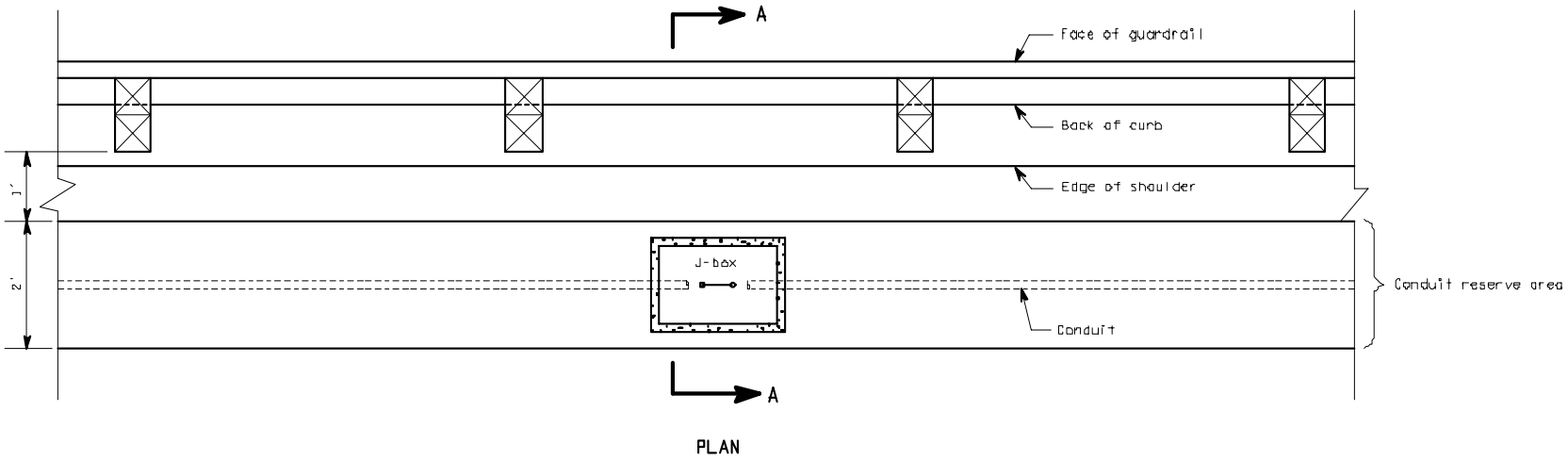
STANDARD PLAN J-9a

	Note 3. change "connectors" to "conductors".	JBN	
DATE	REVISION	BY	APPR'D

APPROVED FOR PUBLICATION

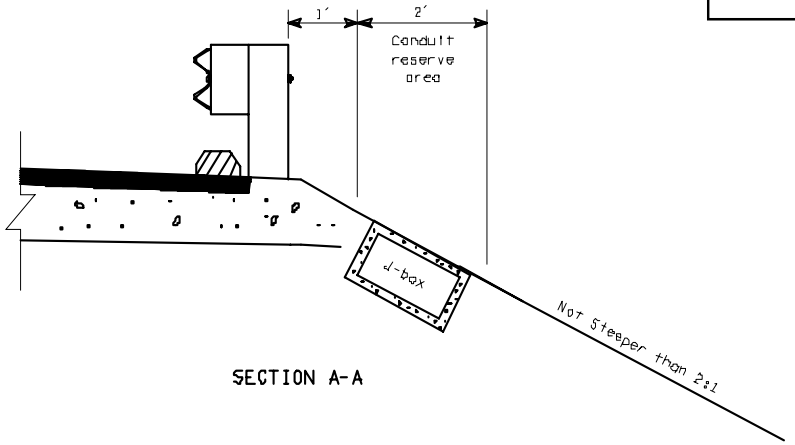
DEPUTY STATE DESIGN ENGINEER — DATE

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON



PLAN

What does a J-box look like?



SECTION A-A

ELECTRICAL CONDUIT PLACEMENT

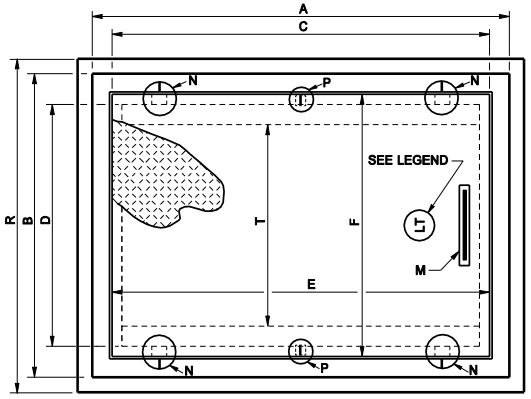
WILLIAM D. BROWN
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES SEPT 11, 2006

STANDARD PLAN J-10

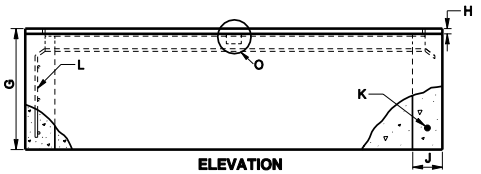
APPROVED FOR PUBLICATION

STATE DESIGN ENGINEER — DATE

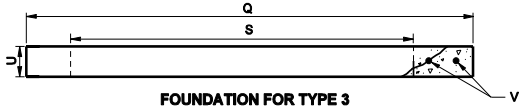
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON



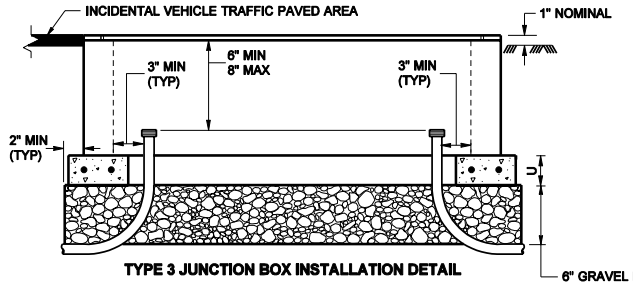
PLAN



ELEVATION

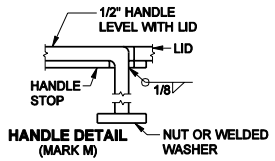


FOUNDATION FOR TYPE 3
JUNCTION BOX

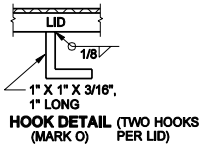


TYPE 3 JUNCTION BOX INSTALLATION DETAIL

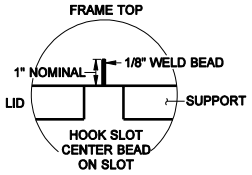
JUNCTION BOX DIMENSION TABLE				
MARK	ITEM	BOX TYPE		
		TYPE 1	TYPE 2	TYPE 3
A	OUTSIDE LENGTH OF JUNCTION BOX	22"	33"	42"
B	OUTSIDE WIDTH OF JUNCTION BOX	17"	22 1/2"	30"
C	INSIDE LENGTH OF JUNCTION BOX	18"-19"	28"	36"
D	INSIDE WIDTH OF JUNCTION BOX	13"-14"	17"	24"
E	LID LENGTH	18"	26 1/2"	36"
F	LID WIDTH	13"	17"	26"
G	DEPTH OF JUNCTION BOX	12"	12"	12"
H	LID AND FRAME DEPTH	5/16"	5/16"	1/2"
J	MINIMUM WALL THICKNESS	1 1/2"	1 1/2"	3"
K	WELDED WIRE HOOP - SIZE NUMBER (SEE NOTE 6)	W 2.9 (6 GAGE)	W 2.9 (6 GAGE)	W 5 (3 GAGE)
L	WELDED WIRE FABRIC - SIZE (SEE NOTE 6)	4 X 4 W 2.9 X W 2.9 (6 GAGE)		
M	HANDLE	N/A	N/A	SEE DETAIL
N	FRAME SLOT MARK	N/A	N/A	SEE DETAIL
O	HOOK	SEE DETAIL	SEE DETAIL	SEE DETAIL
P	LID HOOD MARK	N/A	N/A	SEE DETAIL
Q	OUTSIDE LENGTH OF FOUNDATION	N/A	N/A	48"
R	OUTSIDE WIDTH OF FOUNDATION	N/A	N/A	36"
S	INSIDE LENGTH OF FOUNDATION	N/A	N/A	36"
T	INSIDE WIDTH OF FOUNDATION	N/A	N/A	20"
U	MINIMUM FOUNDATION DEPTH	N/A	N/A	3"
V	WELDED WIRE HOOP -SIZE NUMBER	N/A	N/A	W 5 (3 GAGE)
	CAPACITY - CONDUIT DIAMETERS	6"	12"	24"
	NOTE: A 1% TOLERANCE IS ALLOWED			



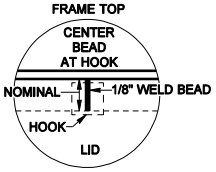
HANDLE DETAIL (MARK M) NUT OR WELDED WASHER



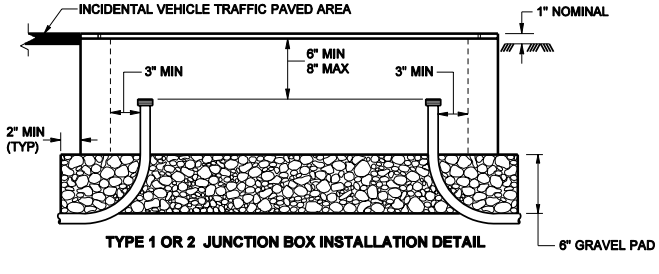
HOOK DETAIL (MARK O) (TWO HOOKS PER LID)



FRAME SLOT MARK (MARK N)



LID HOOD MARK DETAIL (MARK P)



TYPE 1 OR 2 JUNCTION BOX INSTALLATION DETAIL

NOTES:

1. All box dimensions are nominal. Exact configurations vary among different manufacturers.
2. The noted lid thicknesses are overall minimums. The diamond pattern for Type 1 or 2 boxes shall be 28% minimum of overall thickness. The diamond pattern for Type 3 boxes shall have a minimum thickness of 3/32 ".
3. Lid support members shall be 3/16 " min. thick steel C, L or T shape welded to the frame.
4. When specified in the Contract, Type 2 and Type 3 boxes shall be provided with 12" deep extension boxes.
5. A 1/4" NC x 3/4" Stainless Steel Ground Stud with S.S. Nut shall be welded to the bottom of the lid.
6. See the Standard Specifications for alternate use of reinforcement.

LEGEND	
LT — LIGHTING SYSTEM	COMM — COMMUNICATION SYSTEM
TS — TRAFFIC SIGNAL SYSTEM	TEL — TELEPHONE SYSTEM
ITS — INTELLIGENT TRANSPORTATION SYSTEM	
FORM LETTERS WITH 1/8" WELD BEAD.	
ALL DIMENSIONS ARE NOMINAL	

EXPIRES OCTOBER 26, 2002

STANDARD JUNCTION BOX

STANDARD PLAN J-11a

APPROVED FOR PUBLICATION

Harold J. Peterfeso *09-12-01*

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Washington State Department of Transportation

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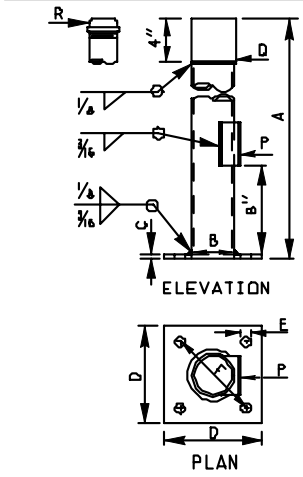
Signal Plans

Signal Plans usually have several pages for each system, plus a signal standards chart showing the details for orienation, foundation, signs, mounting nipples, locations and other information. (see handout)

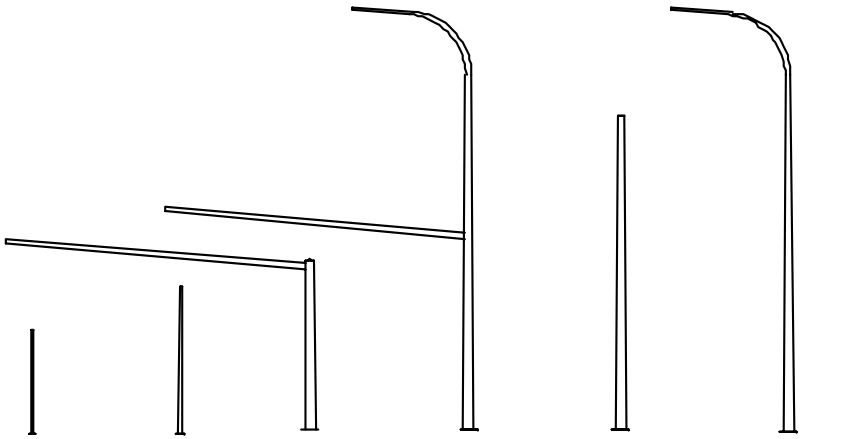
On these plan sheets we will discuss the legend, phase diagrams, loops, wire sizes, labeling, splices, and orientation.

TYPE PPB, PS, & I STANDARD DETAILS



ANCHOR BOLT, NUT, & WASHER SIZES		
MARK	STANDARD	DIMENSIONS
S	TYPE PPB	4 - ½" DIA x 12" x 2"
S	TYPE PS & I	4 - ¾" DIA x 30" x 4"
S	TYPE FB & RM	3 - ¾" DIA x 30" x 4"

SIGNAL STANDARD TYPE DESIGNATIONS



TYPE PPB PED. PUSH BUTTON POST

TYPE PS PED. HEAD STANDARD

TYPE I & RM VEHICLE HEAD AND RAMP METER STANDARD

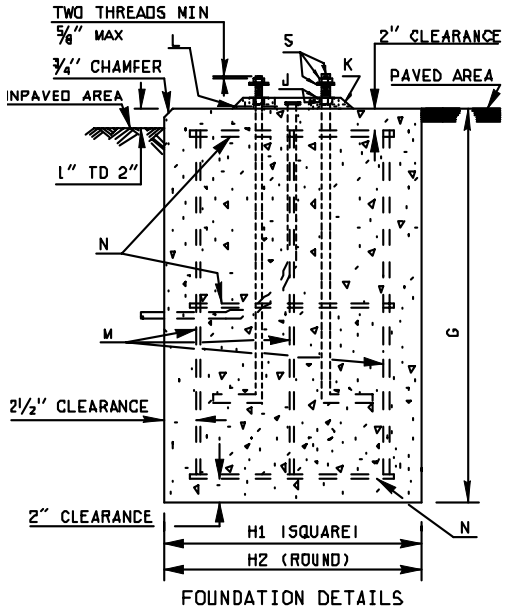
TYPE FB FLASHING BEACON STANDARD

TYPE II MAST ARM STANDARD

TYPE III LIGHTING AND MAST ARM STANDARD

TYPE IV STRAIN POLE STANDARD

TYPE V LIGHTING AND STRAIN POLE STANDARD



TYPE PPB, PS, I, RM & FB STANDARD DIMENSION CHART						
MARK	ITEM	TYPE PPB	TYPE PS	TYPE I	TYPE RM	TYPE FB
A	HEIGHT	4'-6"	8'-0"	10'-0"	SEE SHEET 2	SEE SHEET 2
B	POLE BASE DIA	2½"	*	*	*	*
C	PLATE THICKNESS	½"	½"	½"	SEE SHEET 2	SEE SHEET 2
D	PLATE WIDTH	8"	9"	9"	SEE SHEET 2	SEE SHEET 2
E	HOLE DIA	5/8"	1"	1"	SEE SHEET 2	SEE SHEET 2
F	BOLT CIRCLE	4½"	8½"	8½"	SEE SHEET 2	SEE SHEET 2
G	FOUNDATION DEPTH	1'-6"	3'-0"	3'-0"	3'-0"	3'-0"
H1	FOUNDATION WIDTH	1'-8"	2'-0"	2'-0"	2'-0"	2'-0"
H2	FOUNDATION DIA	2'-0"	2'-3"	2'-3"	2'-3"	2'-3"
J	NUT & WASHER	Four ½"	¾"	¾"	¾"	¾"
K	GROUT PAD THICKNESS	NONE	**	**	SEE SHEET 2	SEE SHEET 2
L	PLASTIC DRAIN TUBE DIA	NONE	¾"	⅞"	¾"	⅞"
M	VERTICAL RE-BAR	NONE	Eight #4	Eight #4	Eight #4	Eight #4
N	HORIZ. RE-BAR HOOP	NONE	Three #4	Three #4	Three #4	Three #4
P	HANDHOLE SIZE	NONE	3½" x 4"	3½" x 4"	3½" x 4"	3½" x 4"
Q	SLIPFITTER DIA (I.D.)	NONE	4"	4"	4"	4"
R	CAP DIA	2½"	NONE	NONE	NONE	NONE

* TAPERED ROUND OR OCTAGONAL SHAFT. 11 GAGE, 4" OD AT SLIPFITTER WELD. TAPER = 0.14 INCHES/FT.
** LEVELING NUT HEIGHT 1" MAXIMUM.
LEVELING NUTS NOT REQUIRED FOR TYPE PPB STANDARD

TOBY D. RICKMAN
STATE OF WASHINGTON
21598
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES OCTOBER 25, 2002

SIGNAL STANDARD TYPE DESIGNATIONS AND TYPE PPB, PS, I, RM, & FB DETAILS

STANDARD PLAN J-7a

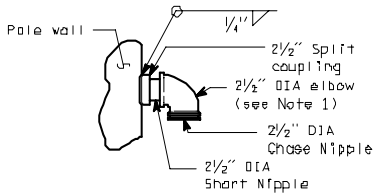
SHEET 1 OF 2 SHEETS

T/DL	WELDING SYMBOL SIZES	MHG
DATE	REVISION	BY

APPROVED FOR PUBLICATION

Harold J. Peterfeso — STATE DESIGN ENGINEER — 09-12-01 DATE

Washington State Department of Transportation

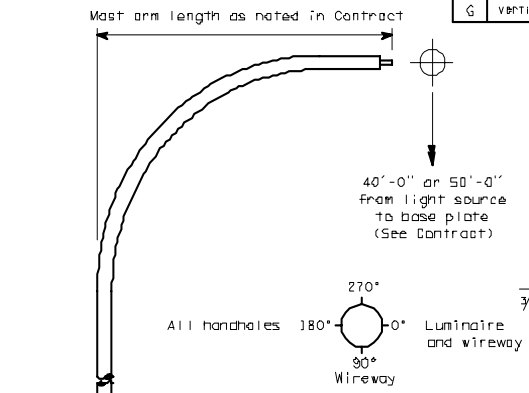


WIREWAY DETAIL

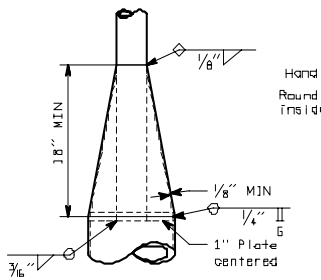
STRAIN POLE DIMENSION CHART								
KEY	ITEM	POLE CLASS (Resultant Horizontal Tension)						
		1900 LB	2700 LB	3700 LB	4900 LB	5600 LB	6300 LB	12000 LB
	Pole gauge	3	3	3	1/0	1/0	1/0	1/0
A	Base plate width	15"	15"	17"	18"	18"	20"	20"
B	Anchor bolt circle diameter	16"	16"	19"	20"	20"	22"	22"
C	Pole base diameter	10"	12"	14"	14"	15"	16"	17"
D	Base plate thickness	1¾"	1¾"	1¾"	2"	2"	2"	2"
E	Anchor bolt size	1"x36"	1¼"x60"	1⅜"x60"	1½"x60"	1½"x60"	1¾"x66"	1¾"x66"
F	Anchor plate size	1"x3"x3"	1"x4"x4"	1"x4"x4"	1"x5"x5"	1"x5"x5"	1"x6"x6"	1"x6"x6"
G	Vertical steel number and size	Eight #5	Eight #5	Eight #7	Eight #7	Eight #8	Eight #8	Eight #8

NOTES

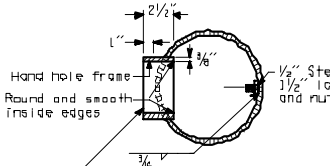
1. 2½" diameter weatherhead may be substituted for the elbow and nipple assembly.
2. Pole shaft shall have 0.14"/ft taper.
3. See Standard Plan J-7a for details.
4. Handholes may be 6" x 4" oval or rectangle.

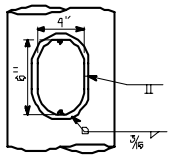


ATTACHMENT POINT ANGLES

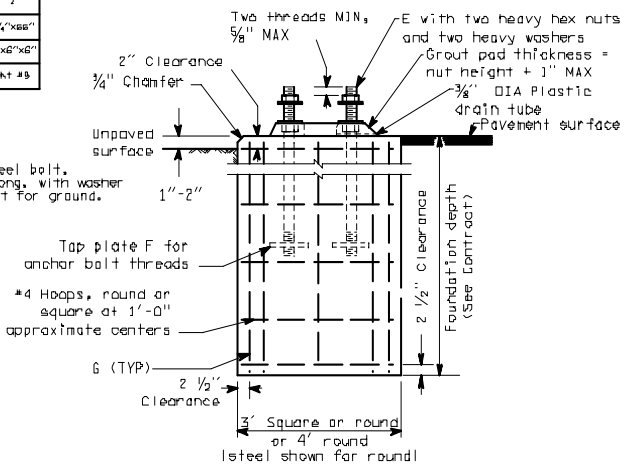


CONE SECTION DETAIL

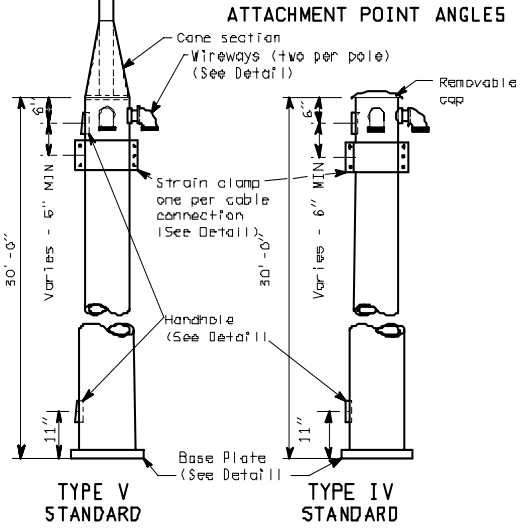




HANDHOLE DETAIL
See Note 4

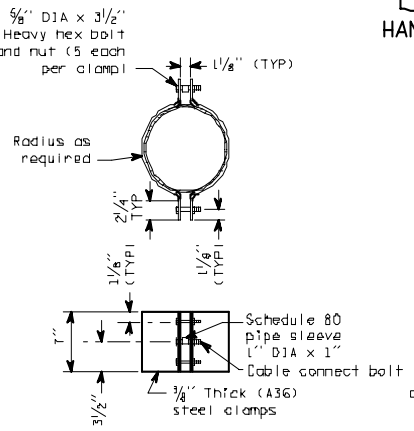


FOUNDATION DETAIL

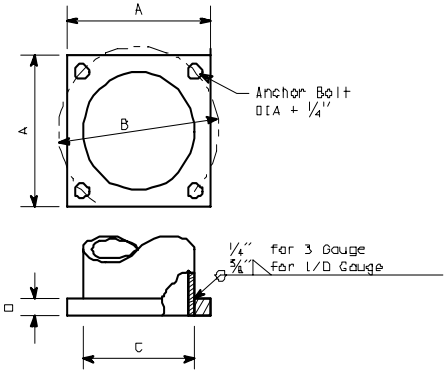


TYPE V STANDARD

TYPE IV STANDARD



STRAIN CLAMP DETAIL



BASE PLATE DETAIL

M. LYNN LWIN
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES JANUARY 17, 1999

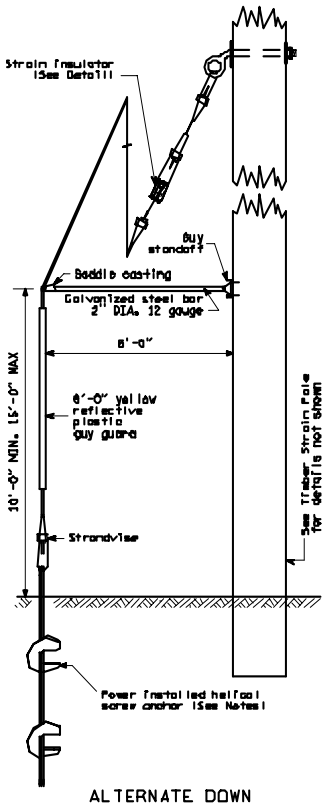
STRAIN POLE STANDARDS TYPE IV AND V

STANDARD PLAN J-7c

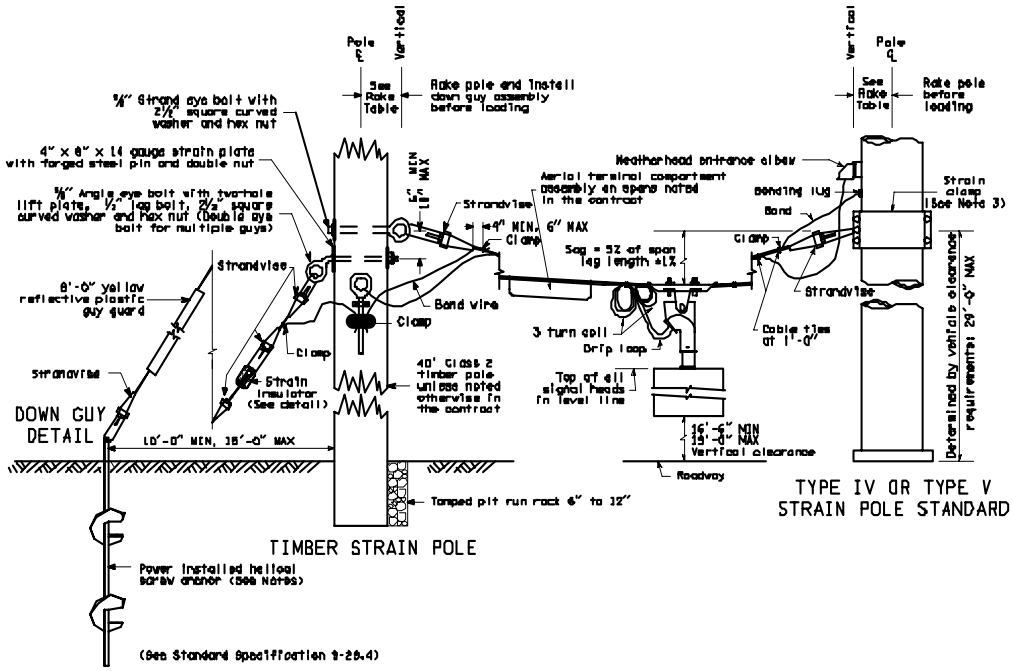
APPROVED FOR PUBLICATION

STATE DESIGN ENGINEER — DATE

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON



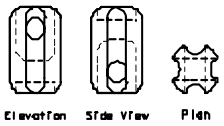
ALTERNATE DOWN GUY DETAIL



NOTES

1. An eight-way expanding anchor may be used as an acceptable alternate to power installed helical screw anchor.
2. If anchor hole diameter is greater than nominal diameter of folded anchors, a 5' cover of 8" to 12" size rock shall be tamped in to replace the disturbed soil immediately above the anchor.
3. See "Strain Clamp Detail" on Standard Plan "Strain Pole Standards: Type IV and Type V".

RAKE TABLE	
POLE CLASS	RAKE
1800#	7"
2100#	6"
2700#	5"
3100#	4"
1800#	6"
2400#	5"
3300#	4"
4200#	3"
TIMBER	6"



STRAIN INSULATOR DETAIL

DAVID K. PEASE
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES JUNE 4, 1999

SPAN WIRE INSTALLATION

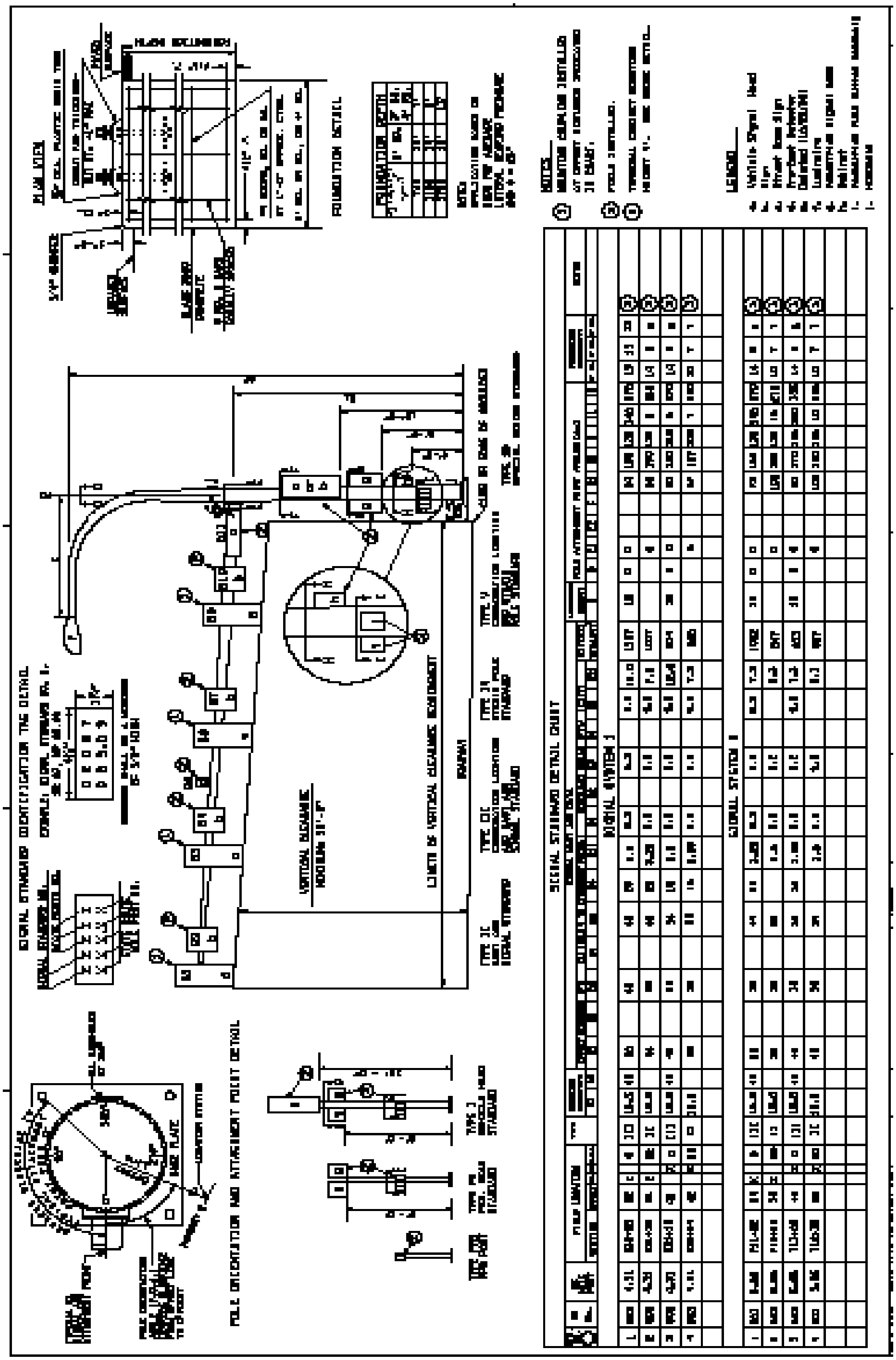
STANDARD PLAN J-7d

	Delete bury depth of pole.	ABN	-
DATE	REVISION	BY	APPR'D

APPROVED FOR PUBLICATION

DEPUTY STATE DESIGN ENGINEER — DATE

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON



Standard Specification

9-29.3 Conductors, Cable

2. Two and three conductor signal control cable shall consist of three No. 14 stranded copper conductors. Each conductor shall have 20-mil polyethylene insulation and a 10-mil PVC jacket. The cable assembly shall be covered with a polyester tape applied with a 10 percent minimum lap. The overall jacket shall be 45-mil PVC.

9-29.3 Conductors, Cable

7 Two conductor shielded (2CS) cable shall have conform to I.M.S.A. specification No. 50-2.

8. Detector loop wire may be No.12 or 14 AWG stranded copper wire, Class B, with chemically cross linked polyethylene type use insulation of code thickness.

And so on for conductor sizes!

"ITS" (Intelligent Transportation System)

Layout

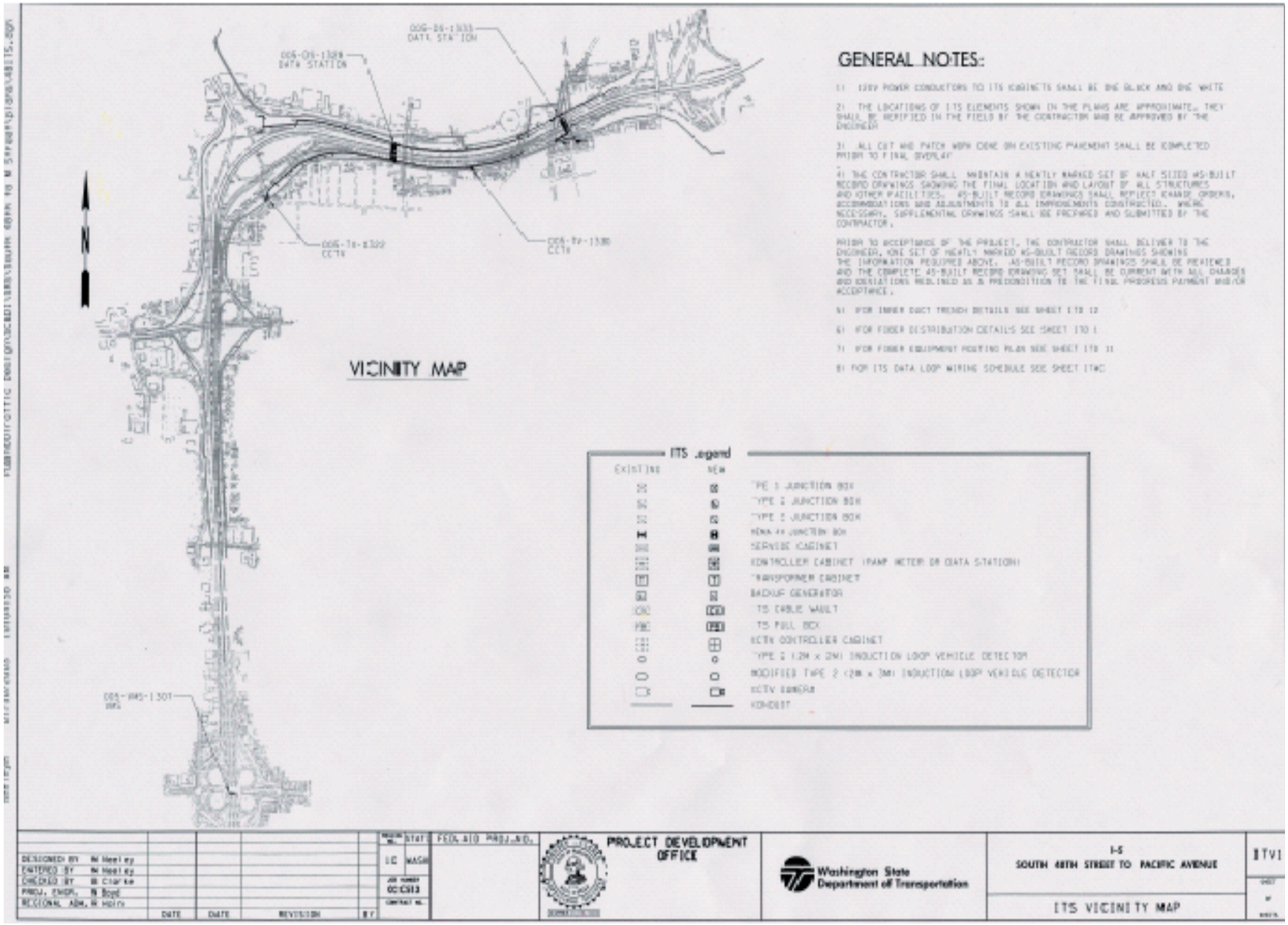
Review the plan sheet and get familiar with the stationing, symbols from the legends, construction notes, wire notes, and components. In the field, review the sites of new construction; verify any conflicts with utilities, right of way, easements, access, flooding, or overhead clearances. Take pictures of existing conditions. Review the feasibility of jacking or drilling for existing roadway crossings. Check the power source and verify it's location.

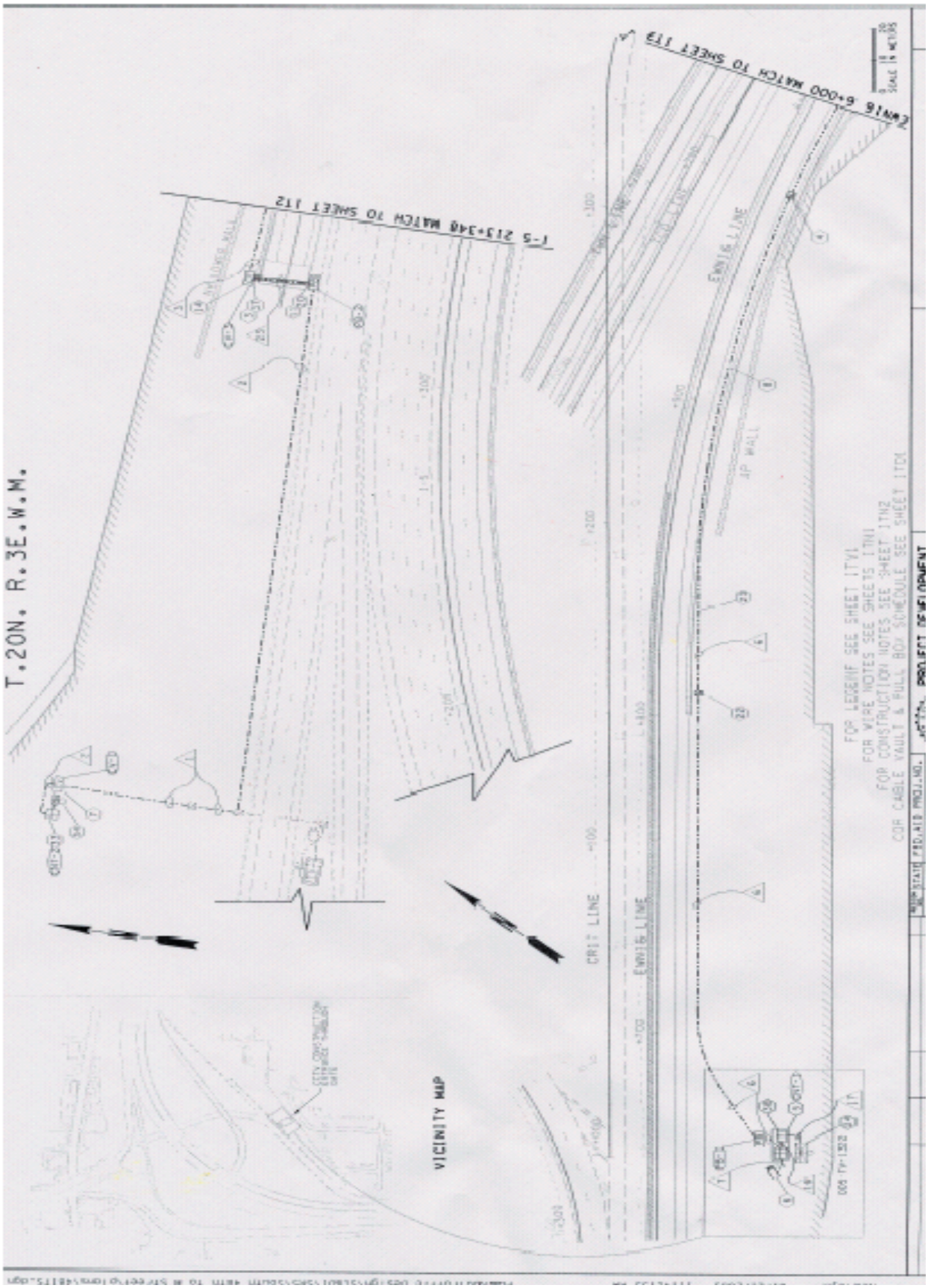
General notes and legend

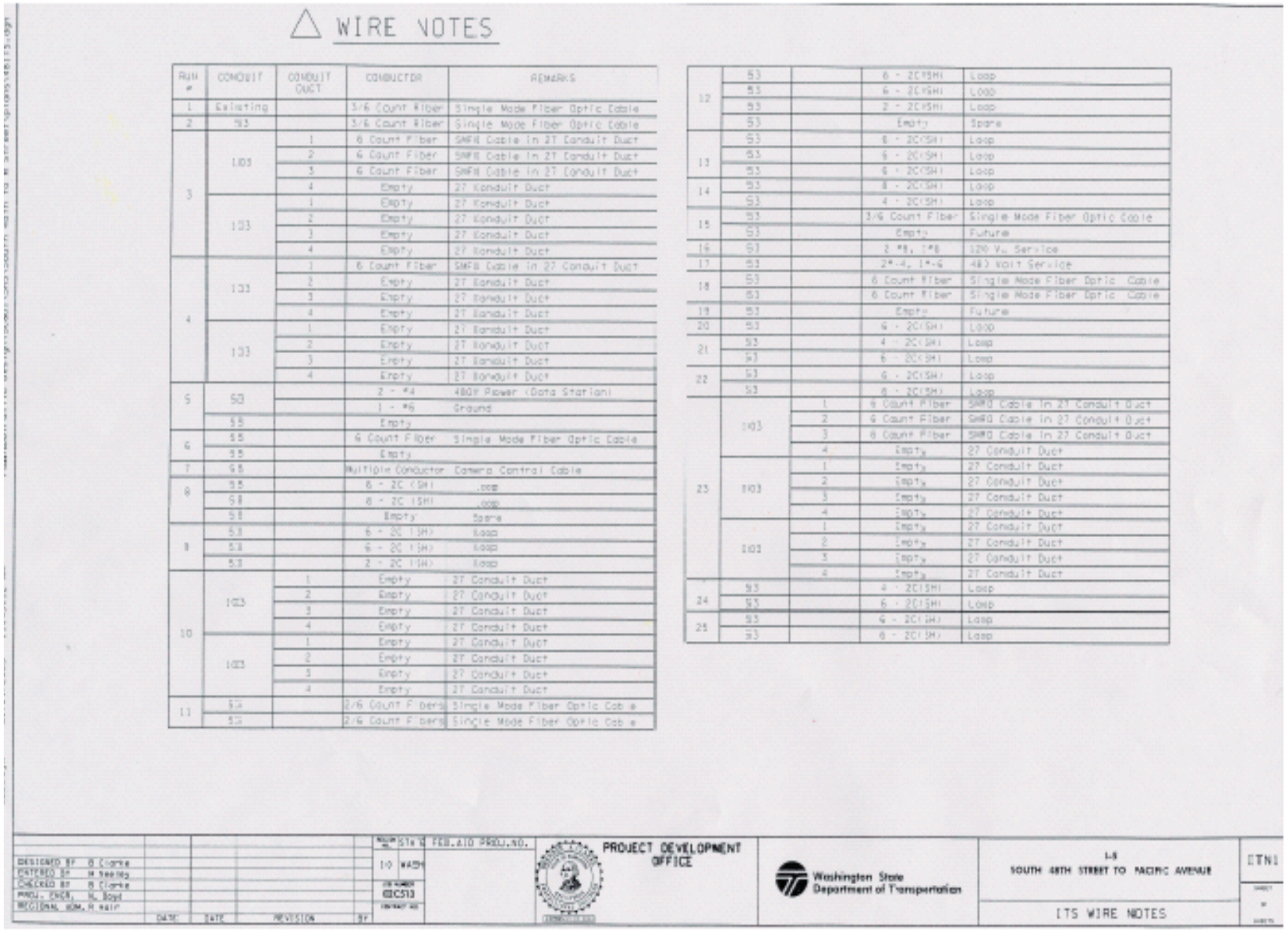
Review the general notes and take care of anything that may be a conflict or requirement, example note 2. Get familiar with the legend and verify any existing items for removal or that will remain.

Wire notes

Verify the run numbers, what size conduit, duct, and wire goes in each. Get samples of each item listed as required in the "QPL" or "RAM".


005-05-1333
DATA STATION
005-05-1328
DATA STATION
005-TV-1322
CCTV
005-TV-1330
CCTV
005-HMS-1307
HMS
N
VICINITY MAP
GENERAL NOTES:
1) 120V POWER CONDUCTORS TO ITS CABINETS SHALL BE ONE BLACK AND ONE WHITE
2) THE LOCATIONS OF ITS ELEMENTS SHOWN IN THE PLANS ARE APPROXIMATE. THEY SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR AND BE APPROVED BY THE ENGINEER
3) ALL CUT AND PATCH WORK DONE ON EXISTING PAVEMENT SHALL BE COMPLETED PRIOR TO FINAL OVERLAY
4) THE CONTRACTOR SHALL MAINTAIN A NEATLY MARKED SET OF HALF SIZED AS-BUILT RECORD DRAWINGS SHOWING THE FINAL LOCATION AND LAYOUT OF ALL STRUCTURES AND OTHER FACILITIES. AS-BUILT RECORD DRAWINGS SHALL REFLECT CHANGE ORDERS, ACCOMMODATIONS AND ADJUSTMENTS TO ALL IMPROVEMENTS CONSTRUCTED. WHERE NECESSARY, SUPPLEMENTAL DRAWINGS SHALL BE PREPARED AND SUBMITTED BY THE CONTRACTOR.
PRIOR TO ACCEPTANCE OF THE PROJECT, THE CONTRACTOR SHALL DELIVER TO THE ENGINEER, ONE SET OF NEATLY MARKED AS-BUILT RECORD DRAWINGS SHOWING THE INFORMATION REQUIRED ABOVE. AS-BUILT RECORD DRAWINGS SHALL BE REVIEWED AND THE COMPLETE AS-BUILT RECORD DRAWING SET SHALL BE CURRENT WITH ALL CHANGES AND DEVIATIONS REDLINED AS A PRECONDITION TO THE FINAL PROGRESS PAYMENT AND/OR ACCEPTANCE.
5) FOR INNER DUCT TRENCH DETAILS SEE SHEET ITS 12
6) FOR FIBER DISTRIBUTION DETAILS SEE SHEET ITS 1
7) FOR FIBER EQUIPMENT MOUNTING PLAN SEE SHEET ITS 11
8) FOR ITS DATA LOOP WIRING SCHEDULE SEE SHEET ITSC
ITS Legend
EXISTING
NEW
TYPE 1 JUNCTION BOX
TYPE 2 JUNCTION BOX
TYPE 3 JUNCTION BOX
HENRY III JUNCTION BOX
SERVICE CABINET
CONTROLLER CABINET (RAMP METER OR DATA STATION)
TRANSFORMER CABINET
BACKUP GENERATOR
ITS CABLE VAULT
ITS PULL BOX
CCTV CONTROLLER CABINET
TYPE 2 (2M x 2M) INDUCTION LOOP VEHICLE DETECTOR
MODIFIED TYPE 2 (2M x 3M) INDUCTION LOOP VEHICLE DETECTOR
CCTV CAMERA
CONDUIT
DESIGNED BY M Neeley
ENTERED BY M Neeley
CHECKED BY B Clarke
PROJ. ENGR. N Boyd
REGIONAL ADM. M Holm
DATE
DATE
REVISION
BY
STATE
WASH
JOB NUMBER
CC 1513
CONTRACT NO.
FED. AID PROJ. NO.
PROJECT DEVELOPMENT OFFICE
Washington State Department of Transportation
I-5
SOUTH 48TH STREET TO PACIFIC AVENUE
ITS VICINITY MAP
ITV1
SHEET
OF
SHEETS


T.20N. R.3E.W.M.
I-5 213+348 MATCH TO SHEET 112
EWIB 6+000 MATCH TO SHEET 113
VICINITY MAP
CRIT LINE
EWIB LINE
AP WALL
FOR LEGEND SEE SHEET 1TV1
FOR WIRE NOTES SEE SHEETS 1TN1
FOR CONSTRUCTION NOTES SEE SHEET 1TN2
FOR CABLE VAULT & PULL BOX SCHEDULE SEE SHEET 1TD1



△ WIRE NOTES

RUN #	CONDUIT	CONDUIT DUCT	CONDUCTOR	REMARKS
1	Existing		3/6 Count Fiber	Single Mode Fiber Optic Cable
2	S3		3/6 Count Fiber	Single Mode Fiber Optic Cable
3	1D3	1	6 Count Fiber	SMFO Cable in 2T Conduit Duct
		2	6 Count Fiber	SMFO Cable in 2T Conduit Duct
		3	6 Count Fiber	SMFO Cable in 2T Conduit Duct
		4	Empty	2T Conduit Duct
	1D3	1	Empty	2T Conduit Duct
		2	Empty	2T Conduit Duct
		3	Empty	2T Conduit Duct
		4	Empty	2T Conduit Duct
4	1D3	1	6 Count Fiber	SMFO Cable in 2T Conduit Duct
		2	Empty	2T Conduit Duct
		3	Empty	2T Conduit Duct
		4	Empty	2T Conduit Duct
	1D3	1	Empty	2T Conduit Duct
		2	Empty	2T Conduit Duct
		3	Empty	2T Conduit Duct
		4	Empty	2T Conduit Duct
5	S3		2 - #4	480V Power (Data Station)
			1 - #6	Ground
	S5		Empty	
6	S5		6 Count Fiber	Single Mode Fiber Optic Cable
	S5		Empty	
7	S5		Multiple Conductor	Camera Control Cable
8	S5		8 - 2C (SH)	Loop
	S8		8 - 2C (SH)	Loop
	S8		Empty	Spare
9	S3		6 - 2C (SH)	Loop
	S3		6 - 2C (SH)	Loop
	S3		2 - 2C (SH)	Loop
10	1D3	1	Empty	2T Conduit Duct
		2	Empty	2T Conduit Duct
		3	Empty	2T Conduit Duct
		4	Empty	2T Conduit Duct
	1D3	1	Empty	2T Conduit Duct
		2	Empty	2T Conduit Duct
		3	Empty	2T Conduit Duct
		4	Empty	2T Conduit Duct
11	S3		2/6 Count Fibers	Single Mode Fiber Optic Cable
	S3		2/6 Count Fibers	Single Mode Fiber Optic Cable

12	S3		6 - 2C(SH)	Loop
	S3		6 - 2C(SH)	Loop
	S3		2 - 2C(SH)	Loop
	S3		Empty	Spare
13	S3		8 - 2C(SH)	Loop
	S3		6 - 2C(SH)	Loop
	S3		6 - 2C(SH)	Loop
14	S3		8 - 2C(SH)	Loop
	S3		4 - 2C(SH)	Loop
15	S3		3/6 Count Fiber	Single Mode Fiber Optic Cable
	S3		Empty	Future
16	S3		2 #8, 1#8	120 V_{ac} Service
17	S3		2#4, 1#6	480 Volt Service
18	S3		6 Count Fiber	Single Mode Fiber Optic Cable
	S3		6 Count Fiber	Single Mode Fiber Optic Cable
19	S3		Empty	Future
20	S3		6 - 2C(SH)	Loop
21	S3		4 - 2C(SH)	Loop
	S3		6 - 2C(SH)	Loop
22	S3		6 - 2C(SH)	Loop
	S3		6 - 2C(SH)	Loop
23	1W3	1	8 Count Fiber	SMFO Cable in 2T Conduit Duct
		2	6 Count Fiber	SMFO Cable in 2T Conduit Duct
		3	8 Count Fiber	SMFO Cable in 2T Conduit Duct
		4	Empty	2T Conduit Duct
	1W3	1	Empty	2T Conduit Duct
		2	Empty	2T Conduit Duct
		3	Empty	2T Conduit Duct
		4	Empty	2T Conduit Duct
	1W2	1	Empty	2T Conduit Duct
		2	Empty	2T Conduit Duct
		3	Empty	2T Conduit Duct
		4	Empty	2T Conduit Duct
24	S3		4 - 2C(SH)	Loop
	S3		6 - 2C(SH)	Loop
25	S3		6 - 2C(SH)	Loop
	S3		8 - 2C(SH)	Loop

DESIGNED BY B Clarke
DRAFTED BY M Feeney
CHECKED BY B Clarke
PROJ. ENGR. W. Boyd
REGIONAL ADM. R Hall

DATE | DATE | REVISION | BY

STATE FED. AID PROJ. NO.
10 #459
JOB NUMBER
EC513
CONTRACT NO.

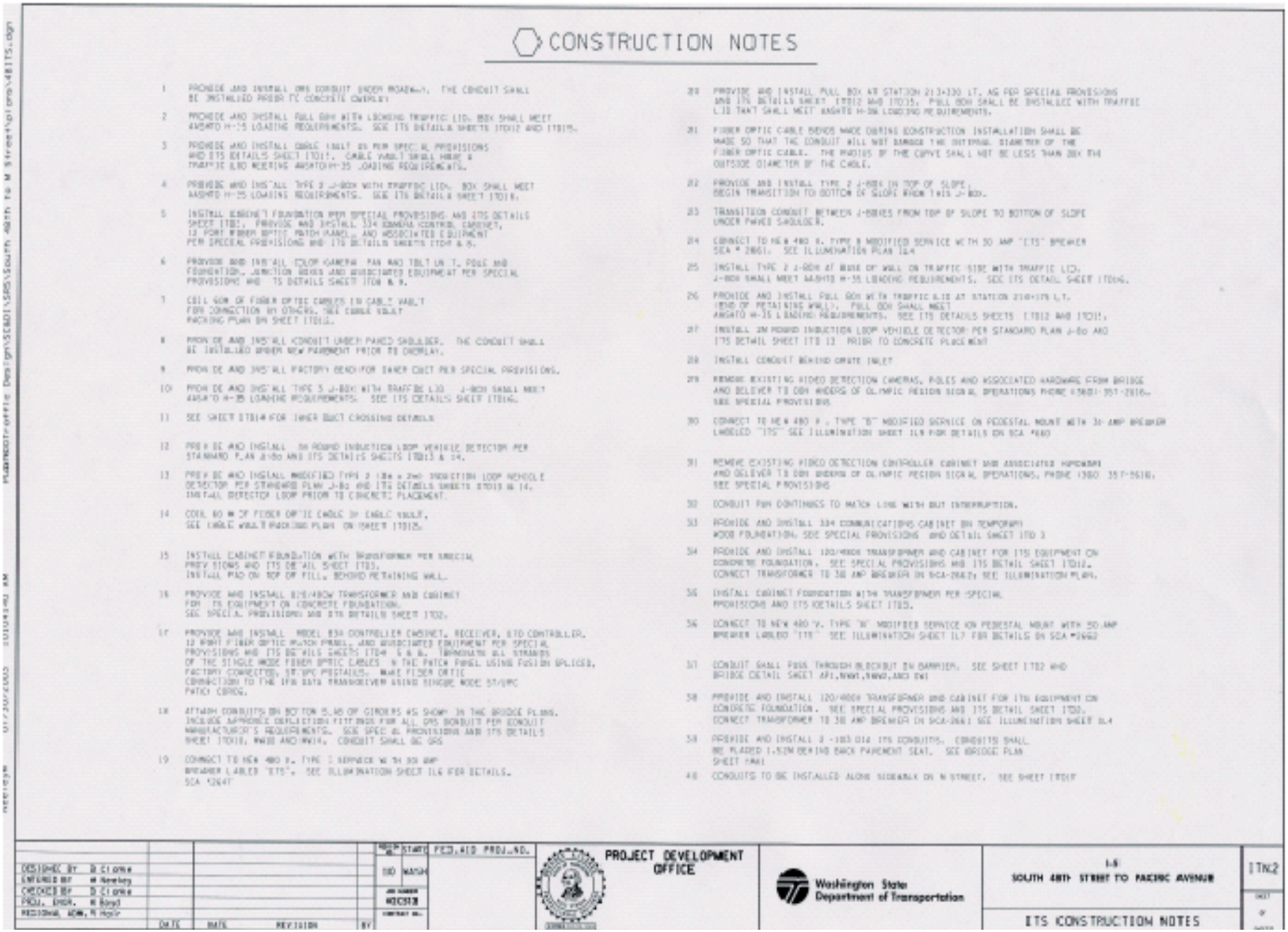
PROJECT DEVELOPMENT OFFICE

Washington State Department of Transportation

I-5
SOUTH 48TH STREET TO PACIFIC AVENUE

ITS WIRE NOTES

ITN1



CONSTRUCTION NOTES

1 PROVIDE AND INSTALL ONE CONDUIT UNDER ROADWAY. THE CONDUIT SHALL BE INSTALLED PRIOR TO CONCRETE OVERLAY

2 PROVIDE AND INSTALL PULL BOX WITH LOCKING TRAFFIC LID. BOX SHALL MEET AASHTO H-25 LOADING REQUIREMENTS. SEE ITS DETAILS SHEETS ITD12 AND ITD15.

3 PROVIDE AND INSTALL CABLE VAULT AS PER SPECIAL PROVISIONS AND ITS DETAILS SHEET ITD11. CABLE VAULT SHALL MEET A TRAFFIC LOAD RATING AASHTO H-25 LOADING REQUIREMENTS.

4 PROVIDE AND INSTALL TYPE 2 J-BOX WITH TRAFFIC LIDs. BOX SHALL MEET AASHTO H-25 LOADING REQUIREMENTS. SEE ITS DETAILS SHEET ITD18.

5 INSTALL CABINET FOUNDATION PER SPECIAL PROVISIONS AND ITS DETAILS SHEET ITD11. PROVIDE AND INSTALL 336 COMMUNICATIONS CABINET, 12 PORT MINIMUM OPTICS PATCH PANELS, AND ASSOCIATED EQUIPMENT PER SPECIAL PROVISIONS AND ITS DETAILS SHEETS ITD14 & 15.

6 PROVIDE AND INSTALL COLOR CAMERA, PAN AND TILT UNIT, POLE AND FOUNDATION, JUNCTION BOXES AND ASSOCIATED EQUIPMENT PER SPECIAL PROVISIONS AND ITS DETAILS SHEET ITD8 & 9.

7 COIL 60M OF FIBER OPTIC CABLES IN CABLE VAULT FOR CONNECTION BY OTHERS. SEE CABLE VAULT PACKING PLAN ON SHEET ITD12.

8 PROVIDE AND INSTALL CONDUIT UNDER PAVED SHOULDER. THE CONDUIT SHALL BE INSTALLED UNDER NEW PAVEMENT PRIOR TO OVERLAY.

9 PROVIDE AND INSTALL FACTORY BEND FOR INNER DUCT PER SPECIAL PROVISIONS.

10 PROVIDE AND INSTALL TYPE 3 J-BOX WITH TRAFFIC LID. J-BOX SHALL MEET AASHTO H-25 LOADING REQUIREMENTS. SEE ITS DETAILS SHEET ITD16.

11 SEE SHEET ITD14 FOR INNER DUCT CROSSING DETAILS

12 PROVIDE AND INSTALL 6m ROUND INDUCTION LOOP VEHICLE DETECTOR PER STANDARD PLAN J-80 AND ITS DETAILS SHEETS ITD13 & 14.

13 PROVIDE AND INSTALL MODIFIED TYPE 2 18m x 2m2 INDUCTION LOOP VEHICLE DETECTOR PER STANDARD PLAN J-80 AND ITS DETAILS SHEETS ITD13 & 14. INSTALL DETECTOR LOOPS PRIOR TO CONCRETE PLACEMENT.

14 COIL 60 M OF FIBER OPTIC CABLE IN CABLE VAULT. SEE CABLE VAULT PACKING PLAN ON SHEET ITD12.

15 INSTALL CABINET FOUNDATION WITH TRANSFORMER PER SPECIAL PROVISIONS AND ITS DETAIL SHEET ITD3. INSTALL PAD ON TOP OF FILL, BEHIND RETAINING WALL.

16 PROVIDE AND INSTALL 120/480W TRANSFORMER AND CABINET FOR ITS EQUIPMENT ON CONCRETE FOUNDATION. SEE SPECIAL PROVISIONS AND ITS DETAILS SHEET ITD2.

17 PROVIDE AND INSTALL MODEL 334 CONTROLLER CABINET, RECEIVER, ETD CONTROLLER, 12 PORT FIBER OPTIC PATCH PANEL, AND ASSOCIATED EQUIPMENT PER SPECIAL PROVISIONS AND ITS DETAILS SHEETS ITD14 & 15 & 16. TERMINATE ALL STRANDS OF THE SINGLE MODE FIBER OPTIC CABLES IN THE PATCH PANEL USING FUSION SPLICED, FACTORY CONNECTED, ST-UPC PIGTAILS. MAKE FIBER OPTIC CONNECTION TO THE IFM DATA TRANSCEIVER USING SINGLE MODE ST/UPC PATCH CORDS.

18 ATTACH CONDUITS ON BOTTOM FLANGE OF GIRDERS AS SHOWN IN THE BRIDGE PLANS. INCLUDE APPROVED DEFLECTION FITTINGS FOR ALL GRS CONDUIT PER CONDUIT MANUFACTURER'S REQUIREMENTS. SEE SPECIAL PROVISIONS AND ITS DETAILS SHEET ITD10, RW20 AND RW24. CONDUIT SHALL BE GRS

19 CONNECT TO NEW 480 V. TYPE 3 SERVICE W/ 54 300 AMP BREAKER LABELED "ETS". SEE ILLUMINATION SHEET IL6 FOR DETAILS. SCA #2647

20 PROVIDE AND INSTALL PULL BOX AT STATION 213+330 LT. AS PER SPECIAL PROVISIONS AND ITS DETAILS SHEET ITD12 AND ITD15. PULL BOX SHALL BE INSTALLED WITH TRAFFIC LID THAT SHALL MEET AASHTO H-25 LOADING REQUIREMENTS.

21 FIBER OPTIC CABLE BENDS MADE DURING CONSTRUCTION INSTALLATION SHALL BE MADE SO THAT THE CONDUIT WILL NOT DAMAGE THE INTERNAL DIAMETER OF THE FIBER OPTIC CABLE. THE RADIUS OF THE CURVE SHALL NOT BE LESS THAN 20X THE OUTSIDE DIAMETER OF THE CABLE.

22 PROVIDE AND INSTALL TYPE 2 J-BOX IN TOP OF SLOPE. BEGIN TRANSITION TO BOTTOM OF SLOPE FROM THIS J-BOX.

23 TRANSITION CONDUIT BETWEEN J-BOXES FROM TOP OF SLOPE TO BOTTOM OF SLOPE UNDER PAVED SHOULDER.

24 CONNECT TO NEW 480 V. TYPE B MODIFIED SERVICE WITH 30 AMP "ETS" BREAKER SCA # 2861. SEE ILLUMINATION PLAN IL4

25 INSTALL TYPE 2 J-BOX AT BASE OF WALL ON TRAFFIC SIDE WITH TRAFFIC LID. J-BOX SHALL MEET AASHTO H-25 LOADING REQUIREMENTS. SEE ITS DETAIL SHEET ITD16.

26 PROVIDE AND INSTALL PULL BOX WITH TRAFFIC LID AT STATION 210+175 LT. (END OF RETAINING WALL). PULL BOX SHALL MEET AASHTO H-25 LOADING REQUIREMENTS. SEE ITS DETAILS SHEETS ITD12 AND ITD15.

27 INSTALL 2M ROUND INDUCTION LOOP VEHICLE DETECTOR PER STANDARD PLAN J-80 AND ITS DETAIL SHEET ITD 13 PRIOR TO CONCRETE PLACEMENT

28 INSTALL CONDUIT BEHIND CURBE INLET

29 REMOVE EXISTING VIDEO DETECTION CAMERAS, POLES AND ASSOCIATED HARDWARE FROM BRIDGE AND DELIEVER TO DOH ANDERS OF OLYMPIC REGION SIGNAL OPERATIONS PHONE (360) 357-2616. SEE SPECIAL PROVISIONS

30 CONNECT TO NEW 480 V., TYPE "B" MODIFIED SERVICE ON PEDESTAL MOUNT WITH 30 AMP BREAKER LABELED "ITS" SEE ILLUMINATION SHEET IL9 FOR DETAILS ON SCA #680

31 REMOVE EXISTING VIDEO DETECTION CONTROLLER CABINET AND ASSOCIATED HARDWARE AND DELIEVER TO DOH ANDERS OF OLYMPIC REGION SIGNAL OPERATIONS, PHONE (360) 357-2616. SEE SPECIAL PROVISIONS

32 CONDUIT RUN CONTINUES TO MATCH LINE WITH BUT INTERRUPTION.

33 PROVIDE AND INSTALL 334 COMMUNICATIONS CABINET ON TEMPORARY WOOD FOUNDATION. SEE SPECIAL PROVISIONS AND DETail SHEET ITD 3

34 PROVIDE AND INSTALL 120/480W TRANSFORMER AND CABINET FOR ITS EQUIPMENT ON CONCRETE FOUNDATION. SEE SPECIAL PROVISIONS AND ITS DETAIL SHEET ITD12. CONNECT TRANSFORMER TO 30 AMP BREAKER ON SCA-2662; SEE ILLUMINATION PLAN4.

35 INSTALL CABINET FOUNDATION WITH TRANSFORMER PER SPECIAL PROVISIONS AND ITS DETAILS SHEET ITD3.

36 CONNECT TO NEW 480 V. TYPE "B" MODIFIED SERVICE ON PEDESTAL MOUNT WITH 30 AMP BREAKER LABLED "ITS" SEE ILLUMINATION SHEET IL7 FOR DETAILS ON SCA #2662

37 CONDUIT SHALL PASS THROUGH KNOCKOUT IN BARRIER. SEE SHEET ITD2 AND BRIDGE DETAIL SHEET AP1,RW61,RW62,AND DW1

38 PROVIDE AND INSTALL 120/480W TRANSFORMER AND CABINET FOR ITS EQUIPMENT ON CONCRETE FOUNDATION. SEE SPECIAL PROVISIONS AND ITS DETAIL SHEET ITD2. CONNECT TRANSFORMER TO 30 AMP BREAKER ON SCA-2661 SEE ILLUMINATION SHEET IL4

39 PROVIDE AND INSTALL 3 -103.014 ITS CONDUITS. CONDUITS SHALL BE PLACED 1.52M BEHIND BACK PAVEMENT SEAT. SEE BRIDGE PLAN SHEET PA1

40 CONDUITS TO BE INSTALLED ALONG SIDEWALK ON N STREET. SEE SHEET ITD17

DESIGNED BY	D. Clarke				STATE	FED. AID PROJ. NO.	PROJECT DEVELOPMENT OFFICE
ENTERED BY	M. Newberg				WASH		
CHECKED BY	D. Clarke				JOB NUMBER		
PROJ. ENGR.	M. Boyd				40C513		
REGIONAL ADMR.	R. Hoar				CONTRACT NO.		
	DATE	DATE	REVISION	BY			

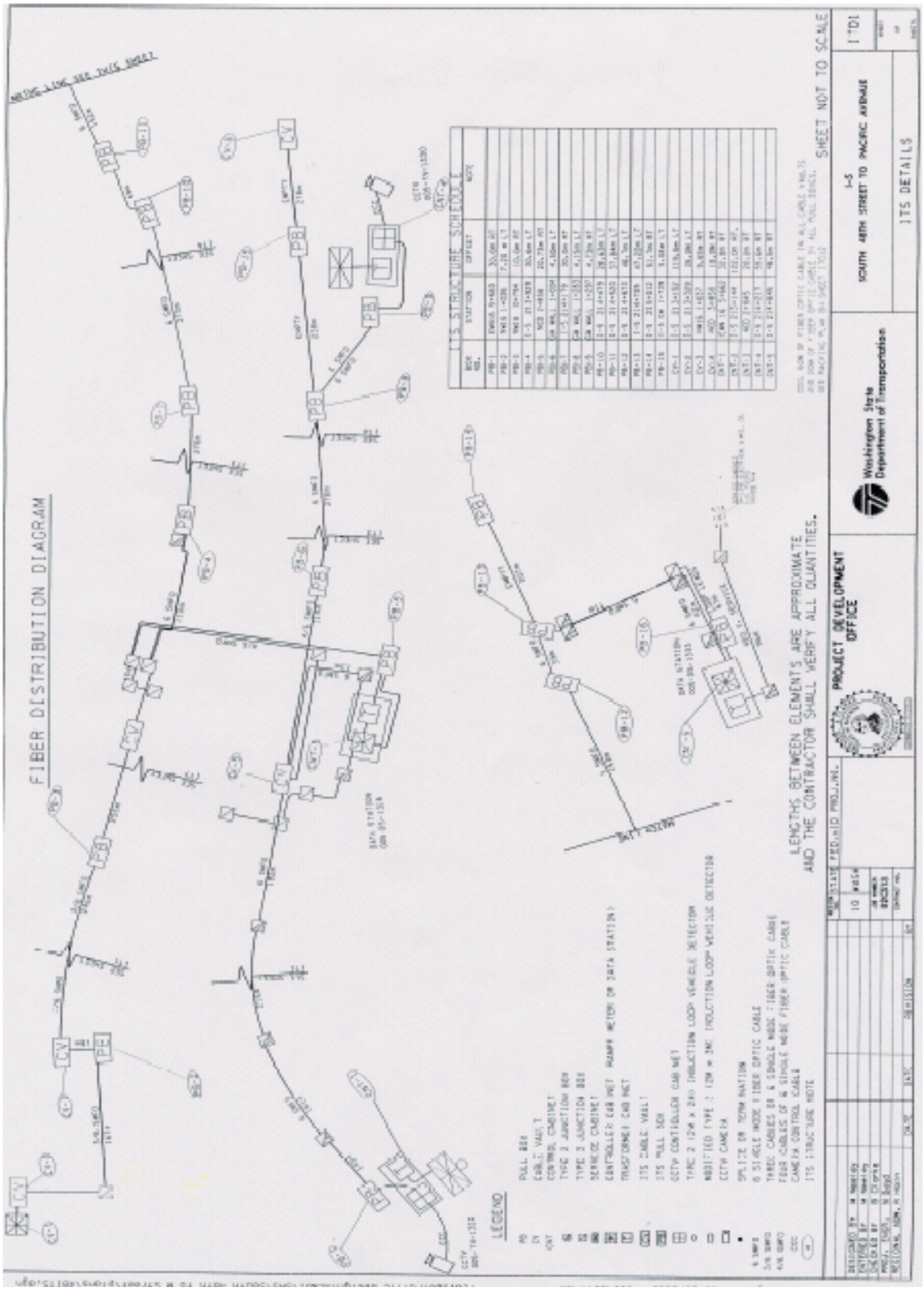
Washington State Department of Transportation

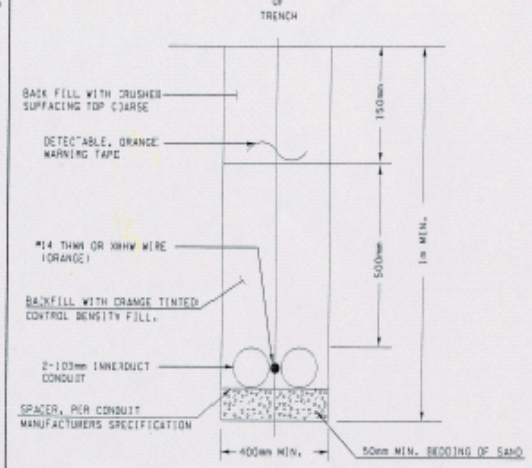
I-5
SOUTH 48TH STREET TO PACIFIC AVENUE

ITS CONSTRUCTION NOTES

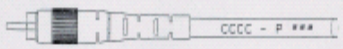
ITN2

SHEET 9


FIBER DISTRIBUTION DIAGRAM
LEGEND
LENGTHS BETWEEN ELEMENTS ARE APPROXIMATE
AND THE CONTRACTOR SHALL VERIFY ALL QUANTITIES.
ITS STRUCTURE SCHEDULE
PROJECT DEVELOPMENT OFFICE
Washington State Department of Transportation
I-5
SOUTH 48TH STREET TO PACIFIC AVENUE
ITS DETAILS
SHEET NOT TO SCALE



MAINLINE TRENCH DETAIL



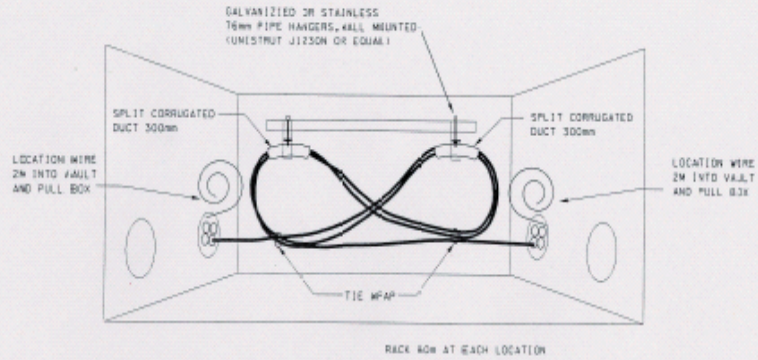
CCCC CONTRACT NUMBER
P LETTER P FOR PATCH CABLES
SEQUENTIAL NUMBER BEGINNING FROM 001

LABEL BOTH ENDS OF THE PATCH PANEL CORD

CABLE LABEL DETAIL

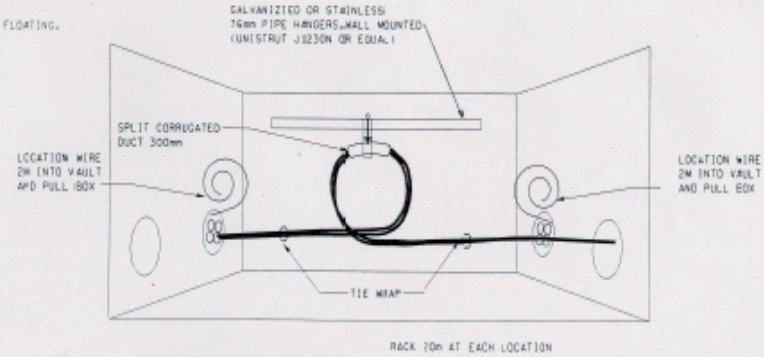
NOTES:

1. UNLESS OTHERWISE SPECIFIED, LINEAR DIMENSIONS ARE BASED ON ROADWAY STATIONING.
2. WARNING TAPE SHALL BE LABELED "WARNING - FIBER OPTIC CABLE BELOW"
3. IF A CONFLICT WITH DRAINAGE, OR OTHER UTILITIES ARISE, THE CONTRACTOR SHALL SUBMIT A PLAN FOR RESOLVING THE CONFLICT TO THE ENGINEER.
4. SECURE CONDUIT IN TRENCH BEFORE BACKFILLING TO PREVENT FLOATING.



RACK 40m AT EACH LOCATION

CABLE VAULT CABLE RACKING PLAN



RACK 20m AT EACH LOCATION

PULL BOX RACKING PLAN

SHEET NOT TO SCALE

PLOTTED: 01/21/2005 11:44:19 AM
Neeley M
P:\ITS\Traffic Design\SCADI\SRS\South 48th to M Street\plans\48ITS.dgn

DESIGNED BY B Clarke				REGION NO.	STATE	FED.AID PROJ.NO.	PROJECT DEVELOPMENT OFFICE	Washington State Department of Transportation	I-5 SOUTH 48TH STREET TO PACIFIC AVENUE	ITD12
ENTERED BY N Neeley				10	WASH					
CHECKED BY B Clarke				JOB NUMBER					ITS DETAILS	SHEET OF SHEETS
PROJ. ENGR. N Boyd				02C513						
REGIONAL ADM. R Hein				CONTRACT NO.						
	DATE	DATE	REVISION	BY						

Construction notes

Read all the notes and decipher any that need immediate attention.

Example;
Note 1, install conduit prior to concrete overlay, when is the overlay?
Note 5, install per special provisions, highlight the note and write the special provision page next to that note on the plan sheet.

Fiber distribution and legend

Get familiar with the legend, read the standard specifications and special provisions concerning fiber cable, splices and so on. How much additional fiber optic cable is required in each pull box?

Miscellaneous details

Look at the special requirements, racking details, labeling requirements, and notes.

Cable Designs

Which cable are you using for your project. Get familiar with your cable and requirements.

9-29.3(1) Fiber Optic Cable

Cables shall be all dielectric cable (with no armoring) and shall be jacketed (sheathed) with medium density polyethylene. The minimum nominal jacket thickness shall be 71 mils. Jacketing material shall be applied directly over the tensile strength members. The polyethylene shall contain carbon black to provide ultraviolet light protection, and it shall not promote the growth of fungus.

The cable shall contain at least one ripcord under the sheath for easy sheath removal.

The fiber optic cable shall withstand a maximum pulling tension of 600 pounds (lbs.) during installation (short term) with no damage and 135 pounds (long term).

Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.

Void areas around the individual buffer tubes shall be protected with a moisture resistant compound as a block against moisture migration.

The fiber optic cables shall be shipped on wooden reels in lengths as specified in the purchase order with a maximum overage of 10%. The diameter of the drum shall be least 20 times the diameter of the cable.

EO OE

Breakout Cables

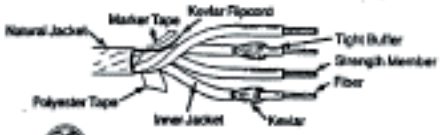
The breakout cable design is one which offers a rugged cable for shorter network designs. This may include Local Area Networks (LAN), data communication, video systems, and process control environments.

A tight buffer design is used along with individual strength members for each fiber. This allows for direct termination to the cable without using breakout kits or splice panels. Because of the increased amount of Kevlar strength members, cables are usually heavier and physically larger than telecom types having equal fiber counts.

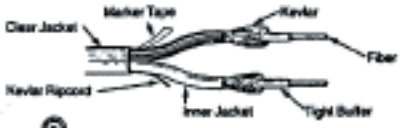
The term breakout defines the key purpose of the cable. That is one could "breakout" several fibers at any location, routing the other fibers elsewhere. For this reason breakout cables should be color coded for ease of identification. Because this cable is used in many building environments where building codes may require plenum cables, most breakout cables are designed to meet the 1987 National Electric Code.

For rugged environments the cable is available in a variety of designs to meet the application and topology desired. Fiber counts from simplex up to 256 are available.

Simplex Plenum

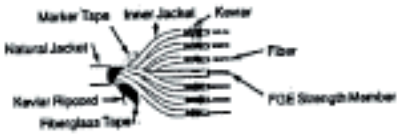


Duplex Ultra Plenum



Duplex Breakout Plenum

Duplex Zip Plenum



Six Fiber Breakout Plenum

Courtesy Belden Wire & Cable

EO

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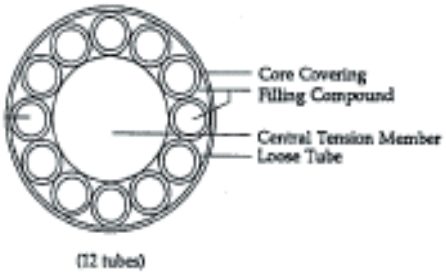
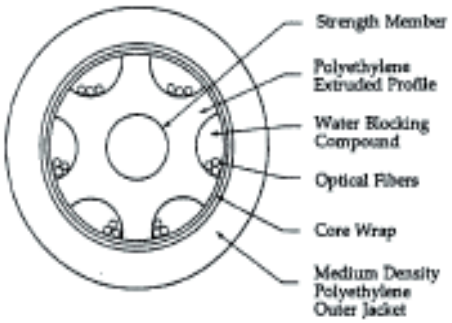
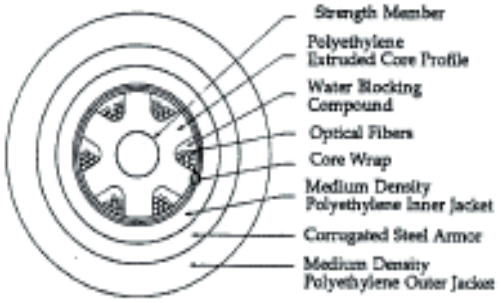
Changing The Fiber Count

These diagrams show how a loose tube optical cable can be used to handle different fiber counts.



6 fiber cable	1 fiber per tube	12 fiber cable	Single Fiber
36 fiber cable	6 fibers per tube	72 fiber cable	Plural Fibers
72 fiber cable	12 fibers per tube	144 fiber cable	Densed plural





Courtesy ITT Valtec

EO

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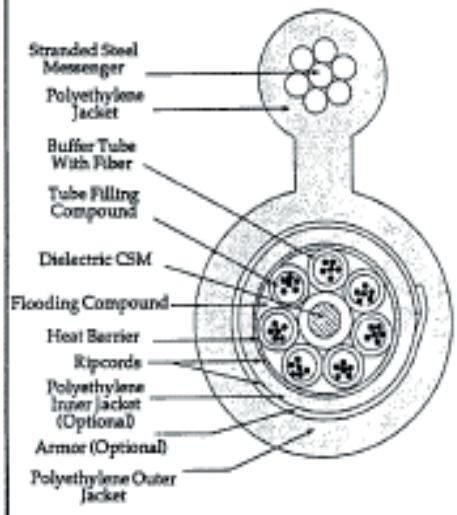
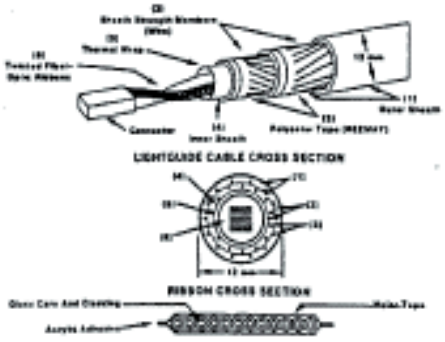
Special Cable Designs

Self Supporting Figure 8



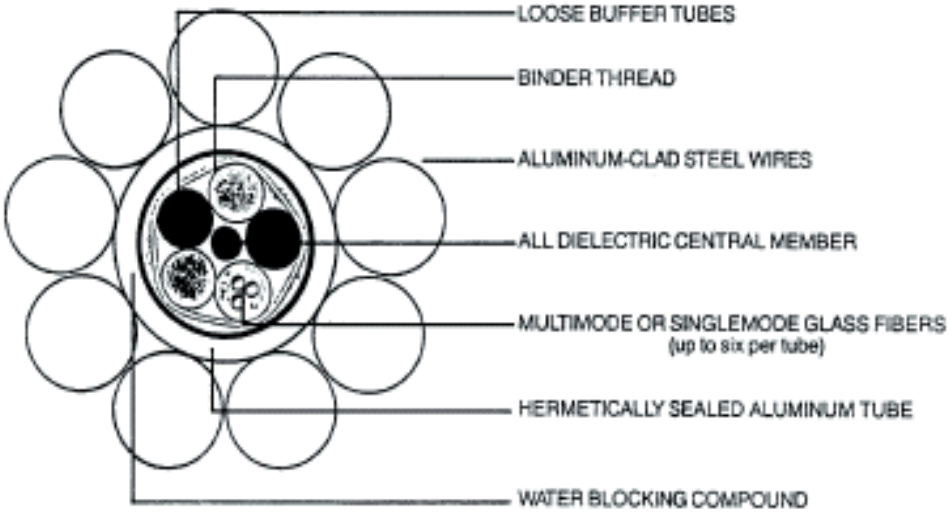
Courtesy Alcatel

Ribbon Cable



Courtesy At&T

Optical Power Ground Wire



Courtesy Kaiser Aluminum

EO

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Hybrid Optical Cable

A unique type of cable designed for multipurpose applications. Both optical fibers and twisted pair wires are jacketed together.

One use for this cable style is when future expansion for optical fibers is being planned. This cable allows for existing copper networks to be upgraded to fiber without requiring new cable to be installed. This can be accomplished without disrupting the existing service.

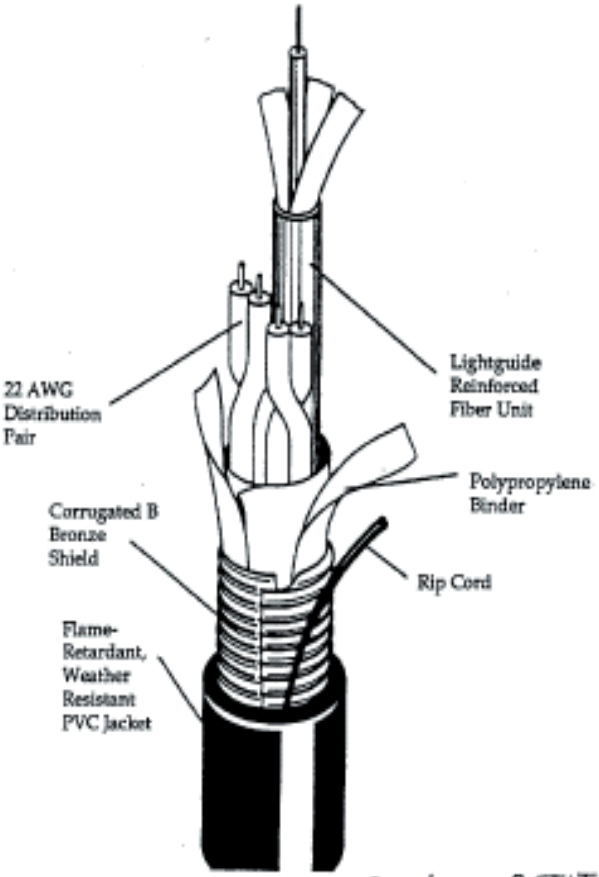
In application areas such as Local Area Networks and Integrated Services Digital Networks, a smooth transition can be made from copper to fiber. This allows the end user to be fiber ready.

The cable designs are available with multiple elements including the specific wire or fiber types (multi or singlemode). These fibers are color coded for easy identification.

Media Elements	3	4	5
Outside Diameter (inches)	0.350	0.375	0.450
Weight/1000 ft. (lbs.)	75	85	100
Max, Tensil Load (lbs.)	100	100	100
Min. Bend Radius for Plowing (inches)	1	1	1

Electrical Characteristics	
Conductor Resistance	33 ohms/1000 circuit ft. (68°F)
Insulation Resistance	10,000 megohms at 1000 ft. (68°F)
Mutual Capacitance	0.083 uF/mile
Voltage Breakdown	10,000 VDC between conductors, and conductors to shield
Attenuation	0.36 dB/1000 ft. at 1 KHz

Optical Characteristics	
Attenuation (singlemode)	0.5 dB/km at 1310 nm 0.5 dB/km at 1550 nm
Temperature Range (operating)	-40°F to + 140°F



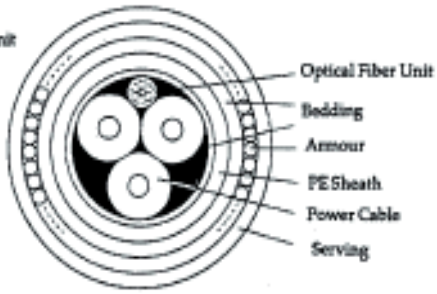
Courtesy of AT&T

EO OE

Cable Designs and Materials

Submarine Cable

Optical fiber cable for shallow sea



Optical fiber and power composite cable

PSOS Cable - (Pre-Stranded Optical System)

A method where the cable and the messenger are wrapped continually around each other. Generally the messenger is kevlar.

Cable Materials

Cable jackets require a variety of materials to best serve the environment to be used in. These materials offer protection from mechanical, thermal, chemical and other environmental concerns.

Polyethylene (PE)

A thermoplastic with good chemical and moisture resistance. Used in Aerial and Direct buried applications.

Polyurethane (PU)

A polymer with excellent abrasion resistance and low temperature flexibility. Excellent for duct applications.

Polyvinylchloride (PVC)

A thermoplastic with good flame and abrasion resistance. A general purpose material used in raceways, duct environments.

Teflon

A fluorocarbon/thermoplastic offering excellent properties in all cable categories with the exception of radiation environments. Used to meet flame, smoke and toxicity codes, Teflon cable is more costly than other cable materials.

Kevlar

An aramid strength member. Kevlar is pound for pound five times stronger than steel.

Kevlar & Teflon are trademarks of the Dupont Corporation.

EO OE

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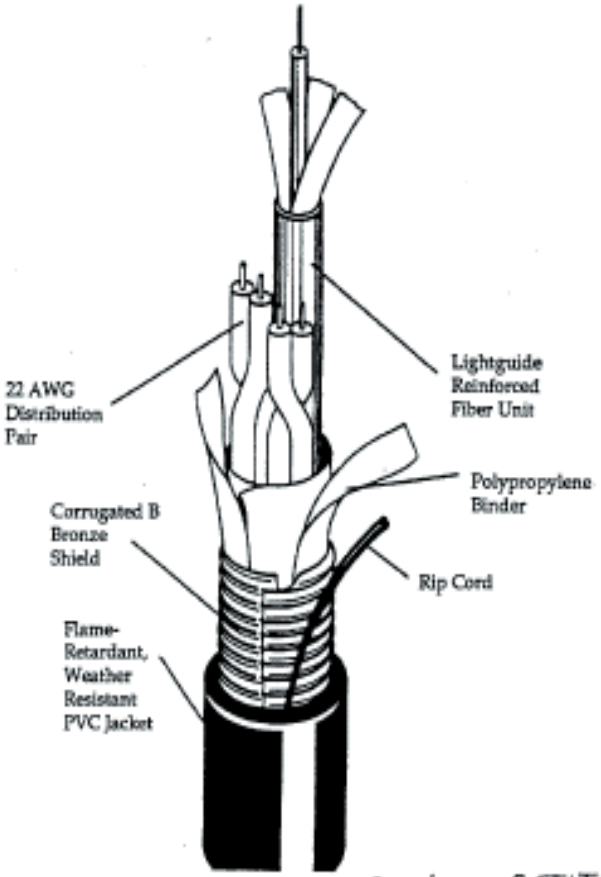

Courtesy of AT&T

EO OE

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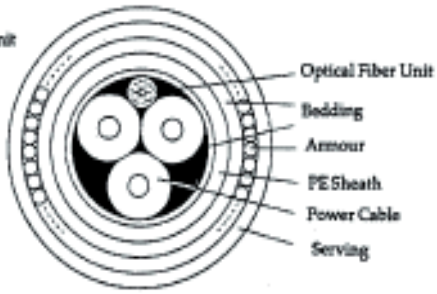

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Part 4

Common Construction Elements for Illumination and Traffic Signals

Foundations

The foundation should be placed in the planned location whenever possible, however, there may be certain conditions that can affect the **planned location** and cause it to be moved. These include:

- Rock
- Bridge footings
- Drainage structures
- Overhead and underground utilities
- Guardrail
- Approval — any site change must be approved

Whether it is moved or not, the foundation's elevation is affected by:

- Pavement overlays
- Widened areas of pavement or roadside
- Side slopes
- Topsoil layers — landscaping
- Always work to finished grades
- Safety features of the pole anchorages

Base for:

- Standards
- Controllers
- Service cabinets
- Transformers

Materials used must be approved:

- Qualified Products List
- Concrete — *Standard Specification* 6-02
- Reinforcing steel — quality requirements, certified
- Conduits and fittings — approved sources, sampling
- Anchor bolts — approved sources and fabrication inspection

Excavation

Right location

Right depth

Right equipment

Foundations on fill areas (bridge abutments) deepened

Foundations on cut slope require relief for slip base function

Broken sidewalk or driveway, remove entire square

Cut all pavements and sidewalks with saw 3 inches deep

Extra depth ordered by Engineer — *Standard Specification* 1-04.4

Forms

Any space around form backfilled and compacted

Set true to line and grade

Rigid and braced securely in place

Hole drilled through form wall for conduit

Trench

Kept to a minimum — just wide enough for the conduit

Reinforcing Steel

According to *Standard Plans*

Correct size bars and grade

Right number of bars

Bars are properly spaced

Bars are securely tied at intersections

Positioned securely in center of form with a minimum 2-inch clearance on all sides

Raised so it does not rest on the ground

Template Set In Place

Positioned to give anchor bolts correct orientation to roadway

Strap template installed top and bottom, M 183M plate washer for illumination, *Standard Plans* J-1b

Correct size anchor bolts that are approved

Hardware

Plates, Bolts, Nuts, and Washers Installed

Anchor bolt tops plumb with template top and bottom

Projection meets *Standard Plans*

Correct spacing between bolts

Approved washers

Conduit Stubs Prepared

18 inches deep below surface minimum

Properly positioned 6 inches outside the form (stub out)

Set to correct height, 3/4 inches above foundation for slip base 2 inches for signal base

Secured in place

Capped or sealed with duct tape

Concrete Placement

Forms and ground moistened

No excess water in excavation

One pour — vibrated thoroughly and carefully

Anchor bolts and conduit stubs held securely in place

Conduit stubs remain capped

Finishing

Struck off to grade

Broom finish

Edge is chamfered according to *Standard Plans*

Curing

White visqueen cover

Three days before form removal

Conduit

Connection to Power Source

Written agreement with utility and WSDOT

Developer is responsible for their projects

Determine exact location of power source

Service conduit as required by serving utility (contractor to coordinate)

Contract Plans

Sizes of conduit, 1 inch minimum except 1/2 inch okay for ground

Number of conduits — per plan

Location of conduit runs — per Standard Plans

Utility locations — any not shown added to "as constructed"

Corrected locations — "as constructed"

Standard Specifications

UL approved label on conduit — before installing

Depth requirements

Types

Galvanized steel

PVC gray color UL approved

Aluminum

Metallic

Used for all conduit above ground

Underground metallic must be hot dip galvanized steel

Aluminum conduit — by specification can be used only at above ground locations

PVC Schedule 40 or 80

PVC never above ground

No reduced couplings on conduit runs

Conduit same size throughout the run

Not used in slip form barrier

Initial Inspection

Material is approved or certified by manufacturer

Right size conduit — black cap indicates 1/2", Red 1/4", blue 1"

No damaged material permitted

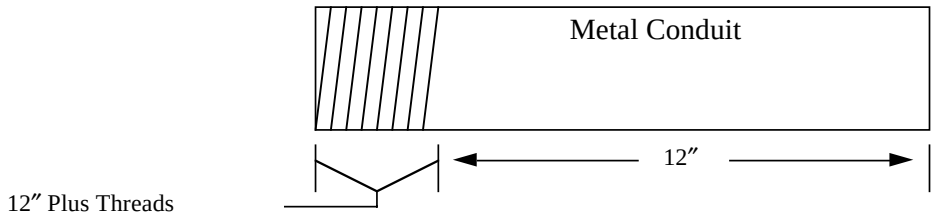
Galvanized conduit coating repaired if damaged — A-9-73

Protective caps on threaded ends of conduit (threads undamaged)

Standard length conduit ends well reamed — no burrs

Galvanized Metal

For each size, send two 12-inch samples, excluding threads from each end of standard length of conduit and a coupling.



When resampling is requested, send twice the number of samples specified above. Be sure the matching end pieces are identified.

Field Inspection

Check for damage to coating

Field cut threads are protected with an approved coating

Standard Specification 9-29.1

Square and true cuts with power band saws

Inside edges of conduit smooth and well reamed, no burrs

Tapered threads used on metallic conduit — no running threads or slip joints

Paint with galvanized repair paint formula A-9-73

Running threads permitted in traffic signal head spiders only

Bending

Total amount of bending on a run does not exceed 360 degrees

Radius at least eight times the conduit's diameter

Radius less than 36 inches shall be steel conduit except in concrete structures

Approved manual or power bending tools used — check with mandrel

Correct size dies — look for workmanship

No crimping, flattening, or other damage during bending (PVC)

NEC 346 Rigid Metal Conduit

NEC 347-13 Rigid Nonmetallic Conduit

Steel Coupling

Ends do not have tapered threads

Threads clean and rust-free

Painted with colloidal copper

Tightened to form good electrical connection and final tightening from the ends prior to backfilling

Hot dipped or electroplated galvanizing

All couplings painted with galvanizing repair paint A-9-73

Trenching

Open trench width shall be 4 inches minimum or conduit diameter plus 2 inches

Minimum depth — 18 inches below curb grade on shoulders

Minimum depth — 24 inches below roadbed

Minimum depth — 48 inches below railroad ties

Placed before base course on new construction jobs

Placing

Unistrut fastening — galvanized or stainless steel

Supports placed within 3 feet of every box, panel, or fixture above ground

Openings have couplings or protective caps — no temporary plugs

Bushings

Galvanized malleable iron with copper, tinned copper, stainless steel lugs, and stainless steel clamping screw, mounting screw, and set screw

Approved bushings installed when couplings/caps removed

Check RAM or QPL to ensure correct bushing used — o.z. Gedney-cat. cut

Backfilling

Thorough — no excavated material left over

Compact careful over PVC — bedded per NEC

Steel conduit substituted for PVC if hard rock encountered

Marker stakes set at ends of buried conduits (protect during construction)

Jacking and Drilling

Minimum $1\frac{1}{4}$-inch steel conduit under railroad and existing pavement

No disruption of pavement

Pits are 2 feet clear of pavement edge

No excessive use of water

Existing Conduits

Conduit for future use

Cleaning mandrel correctly sized pulled through to make sure conduit is not deformed

Clean with compressed air and capped

Junction Boxes (see *Standard Plans*)

Inspection Points

Must be installed before pulling conductors

Check for type of junction box

Check *Standard Plan J-11a* for fill

Installed in location shown in plans

Acceptance stamps on boxes

Properly stored and handled

Lids marked for indicated system (Standard Specification 9-29.2(4))

Installation Procedures

Excavation to right depth and grade

Placed and set to proper grade on 6-inch gravel pad

Backfilled and compacted to be flush with finished grade

Clearances Met

Conduits stop 6 to 8 inches below lid

Conduits no more than 3 inches away from wall nearest entry

Conductors and Cables

Types

Service Entrance Conductors

Neutral Conductor

Equipment Grounding Conductor

Single Conductor

Bonding Jumper

Multi Conductor

Pole and Bracket

Fiber Optic

Two Conductor Shielded Cable

Detector Loop Wire

Four Conductor Shielded Cable (4 CS)

Three Conductor Shielded (3 CS)

Six Pair Communication Cable (6 PCC) two types; arial and underground

Fiber Optic Cable — Single and Multimode

Color Coding System

No pulling conductors until the entire system is complete

Plans show which cables go where:

Black and red wires — illumination

Red, green, or orange — corresponding lens colors of traffic signals

White — neutral wires

No insulation — ground wires

Ground wire in raceway shall be insulated, green in color

Installation

Conduit cleaned of dirt and debris by using:

Compressed air

A cleaning mandrel, correctly sized for each size of conduit, pulled through to ensure that the conduit is not deformed.

Mouse blown or sucked through, which serves two purposes:

It takes the pull string through the conduit, and

It shows that the conduit is not blocked

Pull string or cable tied and taped to conductors

Pulling conductors

All conduit ends reamed and bushings installed to prevent damage to insulation

Approved lubricant used on conductors and conduit openings

Hand pulling — safer

Mechanical pulling — done with dynamometer to measure tension

Cable should not damage PVC while being pulled

At least 18 inches of conductor can be raised outside the junction box

Drip loops shall be provided for:

Aerial conductors entering poles, or

Connect to signal or weather heads

All conductors marked with PVC sleeves (*Standard Specifications* 8-20.3(8))

All coaxial cables shall have heat shrink end caps installed prior to aerial or underground installation of the cables to prevent moisture entry into the cable.

Direct Burial Cables

Rated U-F — under ground feeder — irrigation systems

Rated U-S-E — under ground service entrance — all other underground

Review exceptions for use

Red warning tape must be placed 6 inches above cable

Conductor Splicing

All wiring must run continuously — without splices

Exceptions

Induction loop circuits

Magnetometer circuits

Illumination circuits

Splices can be made only in junction boxes

If temporary splice is required, see electrical inspector for approval

No terminal strips allowed below grade

Induction loop and magnetometer circuits shall use cast epoxy splices with clear rigid molds or rigid re-enterable type splice kits and soldered compression crimp connectors

Under ground illumination circuits shall employ copper crimped connectors and epoxy splice kits with clear rigid molds

Above ground illumination circuits shall employ:

Vice or crimp type pressure connectors

All splicing methods and materials must be approved

Splice insulation, either:

Epoxy or thermoplastic electrical insulating tape, or

Heat shrink — make sure there is no scorching

Method for making cast epoxy splices (see Standard Plan J-8a)

Mold centered, crimped, and/or soldered compression and taped connection

Ends of mold taped thoroughly to seal them

Enough slack left to raise conductors 18 inches above ground level

Funnels inserted

Resin and hardener mixed in bag

Mold filled with epoxy up into funnels

Mold remains as part of splice

Bonding and Grounding

Systems must be grounded mechanically and electrically (see Standard Plan J-9a)

Luminaires

Illumination and Signal Standard

Cabinets

Conduits — where it is impractical to make a threaded metallic joint tight, a bonding jumper shall be used

Metallic — conduit system itself provides ground

PVC — insulated green copper grounding wire must be installed

Any other metallic item containing electrical conductors

Bonding metal covers on junction boxes outside WSDOT right of way

All equipment, grounding conductors, and bonding jumpers must be:

Stranded or solid, bare or insulated, green copper wire

Same size as No. 8 AWG or larger as required in the *Standard Plans*

Grounding rods must be:

Driven into ground within a junction box or 8-inch drain tile with cover

At every service point

Solid electrodes of bonded copper and ferrous core materials

No less than 10 feet long for $^{1}/_{2}$-inch diameter rods

No less than 8 feet long for $^{5}/_{8}$-inch diameter rods

Two service ground electrodes installed a minimum of 6 feet apart

Two approved grounding clamps are used to connect grounding rod to conductor

Approved bushings or clamps used as connections in system

Approved pressure type grounding connectors

Electrical Service

Pole — May Be Timber

Service Cabinet — equipped with WSDOT padlock or lock core

Attached to pole, type A, C

Pad mounted, type B, D, E

Meter Base

Installed at service box

Meets service utility requirements for mounting height

Thermal Service Breaker

Same size as noted in plans

Photo Cells (illumination systems)

Mounted on top of service box, cabinet, or pole

Must point north to read light properly

Service connects to system at weather head mounted on pole, check with serving utility

Servicing utility completes electrical service connections

Part 5

Construction Elements for Light Standard Installation

Light Standard Bases

Slip Base Installation

Concrete set 72 hours or 2,400 PSI

Anchor bolts in place (*Standard Specification* 9-29.6(5))

- Correct line and grade
- Plumb plus or minus 1 degree
- Extend two full threads above hex nuts (*Standard Specification* 8-20.3(4)
- Damaged anchor bolts repaired

Slip plane unobstructed

- No protruding anchor bolts or conduits above the slip plane

Clamping nuts and bolts tightened to specified torque (*Standard Specification* 8-20.3(13)A)

- All bolts, nuts, and washers shall be marked and identified
- Clean and undamaged threads

Galvanized surfaces clean and smooth, which:

- Reduces friction between slip plates
- Prevents slackening of bolt tension

Washers placed between bottom slip plate and keeper plate.
Keeper plate 28 gauge ASTM A526 Coating G90

Grout Pad

- Fill space between foundation and anchor plate
- Does not extend above bottom of the anchor plate

Wiring done according to detail in *Standard Plans J-1e*

Fixed Base Installation

Same steps as slip base installation, except:

- Anchor bolts must be rotated 180 degrees before pour
- Anchor plate and bottom slip plate eliminated

Lighting brackets

- Mount structures on bridges and retaining walls

Slip base inserts, used on:

- New standards, or
- Modifying existing standards

Breakaway Couplings

Note: Contact signal superintendent, electrical inspector, or signal maintenance for help on proper installation

Existing Foundations

Anchor nuts, pole, grout pad, and leveling nuts removed

Conduits cut off maximum of 2 inches above foundation

Damaged anchor bolts repaired

Anchor bolts cut off $2^{1}/_{2}$ to 3 inches above foundation

Couplings installed within $^{1}/_{8}$ to $^{3}/_{8}$ inch of foundation

Couplings leveled

Wire like the light standard detail (J-le)

Same for new foundations

New Foundations

Anchor bolts installed with tops $2^{1}/_{2}$ to 3 inches above foundation

Marked and staked to prevent damage from graders

Couplings installed within $^{1}/_{8}$ to $^{3}/_{8}$ inch of foundation

Couplings leveled

Pole and Mast Arm Erection

Poles and mast arms undamaged

No bending or twisting during loading, unloading, or erection

Rope or nylon slings used

Poles and mast arms must be inspected by Headquarter's fabrication inspector and stamped

Poles set and plumbed by adjusting nuts

Washers, nuts, and skirt installed to manufacturer's specifications

Pole raked

Metal tag riveted to pole above handhole, includes:

Luminaire number, wattage, and voltage

Paint 3-inch series C numbers 3 feet above base facing traveled way

Pole matches Standard Plans and/or Contract Plans

Correct height

Mast arms are proper length

Types

Permanent standards made of either:

Steel

Aluminum or concrete

Temporary standards, usually made of:

Timber, and

Should be buried at least 10 percent of pole length plus 2 feet

Plumbed or raked as directed

All cuts and holes treated with preservatives

Retrofitting and relocating existing equipment

Luminaire Installation

Material used is approved

Pole at correct height

Mast arm at correct length

Mast arm is perpendicular to traveled way

Socket position

Shown in:

Packing slips — shows position set at factory

Plans and special provisions

Test report — always governs what position should be

Proper luminaire lens installed

Lamps correct type and wattage

Lamp marked with date of installation on ballast and lamp

NEMA identification tag applied to underside of luminaire

Color indicates bulb type — Red Halide, Blue Mercury, Gold Sodium

Number when multiplied by ten indicates wattage

Tag should be visible from ground level

Light standard wiring details (J-le)

Photoelectric controls

Plug-in — 120 volt 60 Hz

Meter base — potentiometer

Part 6

Construction Elements for Traffic Signal Installation

Installing Traffic Loops

Wire to be used is inspected

Meets requirements of Division 9-29 of *Standard Specifications*

Right type and size of wire

Right type and thickness of insulation

Wire to be used has been approved

No visible damage to wire or insulation

Conditions before wire placement

After grinding the pavement

Before final lift of asphalt

Pavement is dry and clean

Identify stop bar location — lay it out

Loop outlined in chalk

Locations and dimensions correct

Saw cutting

1/4 inch wide, except lead-in saw cuts are 1/2 inch wide

2 1/2 to 3 inches deep

Corners overlap — small as possible

Loop should not make more than a 45-degree bend

Corners cut to full depth

Air blasting

High pressure washing and dried with 100 psi minimum air pressur

Thoroughly cleaned immediately before wire placement

Saw cuts and weather must be dry

Placing wire

One continuous wire

Right number of wire twist from loop to junction box, Standard Plan J-8a

Installed with blunt-nosed wooden wedge — nothing sharp

Pressed down all the way around

No slack, kinks, or folding in wire

Reverse twist on each successive pair installed

Backer Rod

High temperature pieces 2" long @ 24" O.C.

Approved sealant used

No air bubbles or foam entrapped in slots

Splicing (See Standard Plans J-8A, B & C)

If loop splices are not installed immediately after the installation of the loop leads into the adjacent junction box, the ends of the two conductor "home run" cable shall be sealed with heat shrink end caps to prevent entry of moisture into the two conductor cable, Standard Plan J-8A.

Testing the Loops and Lead-Ins

Contractor runs tests, inspector closely monitors them

Tests measure resistance to determine if system is operating properly (existing)

Test A

Measures DC resistance between two lead-in cable wires

Uses volt-ohm-meter

Tests continuity of system — no broken wires

Resistance must not exceed 5 megohms

Test B

Made between lead-in cable shield and ground prior to connection

Megohm meter test at 500 volts DC

Tests grounding — if insulation is good

Resistance must equal or exceed 100 megohms

Test C

Made between loop circuit and grounding

Meggar test

Tests grounding — if insulation is good

Resistance must equal or exceed 100 megohms

Test D

An inductance test to determine the inductance level of each loop

150 microhenries minimum for Type I and 75 for Type II

Same tests must be run on lighting systems

Submit test results to P.E.

Erecting Signal Standards

Field verification — right location

The concrete in the foundation shall be set to 2,400 psi before erection

Poles mounted on foundations

According to plans

Two full threads above the nut minimum

Poles and mast arms must be inspected by Headquarter's fabrication inspector and stamped

Damaged galvanizing repaired with zinc-rich paint, Formula A-9-73

Signal standard number on metal tag riveted to pole above handhole

If signal standard also supports luminaire:

Disconnect connectors used, complete with pole and bracket cable

Illumination wiring used that conforms to slip base detail plan

All pole entrances field drilled

No drilling on mast arms, except for pre-emption indicators or detectors

Field welding

Contractor must obtain prior approval by submitting welding plan

Done by certified welders

Poles plumbed

If span wires are used:

Sag shall be 5 percent of span length, plus or minus 1 percent

Tether wires used to secure heads in high wind areas

$16^{1}/_{2}$ to 19 feet vertical clearance above roadway

Installing Controllers

Site verification

Same as plan location

Oriented for maintenance (check with them) and safety

Controller submitted to Materials Lab for testing

As soon as it is available, but at least four to six weeks before installation

Controller identified by contract number

Foundations built — same requirements as other foundations

Conduits installed

Approximately 2 inches above foundation

Centrally located within foundations

One 2-inch spare (to a type 3 J-box) for future use

Cabinets placed and equipment connected

They come factory wired and ready for operation from Materials Lab or Signal Shop

Field wiring is connected to field terminal strips

Marked with service agreement letters and numbers (only service cabinets)

2-inch minimum clearance for control equipment

Installing Signal Heads

Type

Normal, programmed, or LED

For vehicles, or

Pedestrians, which can use either approved:

Symbols, or

Words

Sizes

8-inch heads

12-inch heads

Ways of mounting

Pole mounted H, K

Post mounted F, D

Mast arm mounted M, L, LE

Span wire mounted Q, R, S

Heads should not be installed until all other equipment is in place

May be mounted earlier if faces covered with black opaque material

Work done according to plans

Right hardware used

Right assembly procedures followed

Right dimensions and clearances

Emergency pre-emption

Opticoms

Work done according to special provisions

Turning on the Power

Maximum flashing period is five days

Covered with black material if not flashing

Change from flash to stop and go

No later than 2:00 p.m. on any day

Not on:

- Fridays,
- Weekends,
- Holidays, or
- Day preceding holiday

Not until all signs, stop bars, pedestrian crossings, or other traffic control devices are installed

Signal Should Function as Intended

Traffic Control

Discussed in advance with contractor

Police or flaggers should direct traffic

Qualified representative of controller supplier shall be present at the change

Traffic should flow smoothly and safely

As-Constructed Plans

Make changes as they occur

Should be as detailed as possible

Take accurate and detailed notes during all phases of construction

Make sure contractor submits any corrected shop drawings *Standard Specifications* 8-20.3(17)

RCW 19.122.020 underground facilities located within 24 inches of outside dimensions (see Appendix E)

Changes to as-built are made using red pen medium line width

Partially removed foundations must be shown

Send a set of correct plans to regional Signal Maintenance shop.

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Appendix A

References to Standard Specifications

Appendix A References to Standard Specifications

2004 Edition

Conduit	9-29.1
Junction Boxes	9-29.2
Conductors	9-29.3
Messenger Cable	9-29.4
Pole Line Hardware	9-29.5
Light and Signal Standards	9-29.6
Luminaire Electrical Connections	9-29.7
Ballasts, Transformers	9-29.9
Luminaires	9-29.10
Control Equipment	9-29.11, 13
Splice Materials	9-29.12
Vehicular Signal Heads	9-29.16, 17
Detectors	9-29.18
Pedestrian Signals	9-29.19, 20
Service Cabinets	9-29.24
Other Cabinets	9-29.25

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Appendix B

References to Construction Manual

Relationship With the Contractors	1-2.2C
Construction Safety	1-2.2I(4)
Traffic Control and Signing	1-2.3
Relations With the Serving Utility	8-20.3
Inspection	8-20.4
As-Built Plans	8-20.5
Foundations	8-20.6A
Conduit	8-20.6B
Junction Boxes	8-20.6C
Wiring	8-20.6D
Grounding	8-20.6E
Lighting Standards (Strain Poles)	8-20.6F
Existing Illumination Systems	8-20.6G
Service Equipment	8-20.6H
Traffic Signal Systems	8-20.6I
Testing	8-20.6J
Electrical Safety Tags	8-20.6K
Prevention of Conduit Corrosion	8-20.7
Measurement and Payment	8-20.8

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Appendix C

Reference Documents

1. WSDOT current *Standard Specifications*, M 41-10
2. Amendments to WSDOT current *Standard Specifications*
3. WSDOT *Construction Manual*
4. National and State Electrical Codes
5. Department of Labor and Industries, RCW 19.28.510
6. Information on locates

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Appendix D

Inspector Refresher Checklist

Signalization and Illumination

Common Construction Problems

This work, as well as other electrical work and signalization, is very specialized requiring the services of a licensed electrical contractor. Few inspectors have had sufficient experience to thoroughly and adequately inspect this type of work. To overcome this problem, it is recommended that the Regional Electrical Inspector work closely with project personnel to assure plan and specification compliance.

Experience has proven that many potential problems can be averted or minimized by a special preconstruction meeting involving the electrical contractor or sub-contractor, project personnel, and the Signal Shop Superintendent or Regional Electrical Inspector. This special preconstruction meeting should be held immediately prior to starting the electrical work. It is especially important that the contractor's job superintendent or foreman attend this meeting. The conduct of the meeting should be informal and cover the real "nuts and bolts" problems that may be expected or that have occurred on previous projects.

Over the years a number of recurring construction errors have been discovered regarding electrical work either at final inspections or later when maintenance work was being performed. A list of these more common errors follows. This list is included as a reminder for inspection personnel and should not substitute for the above recommended preconstruction meeting.

Conduit Installations

1. Nonmetallic conduit (PVC) may be used where specified. Installation shall conform to the NEC Article 347 Rigid Nonmetallic Conduit.
2. Minor bends in conduit without proper use of bending tool causing partial collapse of conduit and resultant problems pulling wire through conduit.
3. Use of rocky material for conduit backfill instead of fine soil or sand which results in eventual collapse of conduit.
4. Failure to clean dirt and moisture from conduit prior to pulling wire.
5. Failure to cap stub ends and free ends of conduit resulting in intrusion of soil and moisture.
6. Conduit buried at less than required 18 inches (600 mm) depth below roadbed causing future maintenance problems such as inadvertent cutting or mashing of conduit.
7. Placement of conduit by other than a bona fide licensed electrical contractor.
8. Placement of conduit at locations other than shown on the plans without proper indication on the as-constructed plans.
9. Use of flexible conduit in place of rigid steel elbows.
10. Use of water pipe type conduit and fittings in place of conduit approved for electrical use.

11. Failure to prevent grout from entering conduit while grouting pole base.
12. Improper location of conduits in foundation.

Expansion Fittings

1. Failure to install a proper conduit expansion unit at structure expansion joints.
2. Failure to provide expansion couplings on long runs of PVC conduit may result in buckling of the conduit.

Foundations

1. Improper or wrong size anchor bolts installed or installed out of alignment for proper pole base plate fit.
2. Foundation not set at proper elevation. Too high or too low an elevation to permit proper action or exposure of the slip base or breakaway base.
3. Improper backfilling or lack of mechanical tamping around foundation may result in eventual tipping of the foundation and pole.
4. Failure to grout under the base of pole.
5. Failure to check contract plans for foundation size and constructed in accordance with Standard Plan Drawing.

Pole Erection

1. Rotation of signal mast arm 180° from designed position.
2. Failure to accurately plumb poles after all hardware is in place.
3. Grouting of poles before all hardware is in place and the pole accurately plumbed.

Wiring

1. Failure to use a wire lubricant prior to pulling through conduit may damage the wire, its insulation, or the conduit.
2. Use of extreme force and speed to pull wire, such as with a vehicle, may damage wire, its insulation, or the conduit, and is not allowed.
3. Failure to pull signal cable by hand may damage insulation.
4. Unauthorized splices in buried or concealed junction boxes that create future maintenance problems.
5. Failure to use insulated bushings at conduit entrances to metal junction boxes, cabinets, and terminal boxes.
6. Unauthorized splices in signal cable. The cable must be continuous between terminal connections.
7. Use of wrong type of size of wire or wire with improper insulation.
8. Failure to use approved wire connectors.

Signal Loop Wiring

1. Improper splicing of signal loop detector lead-in wire which may break down causing moisture to enter the splice and ground the loop making it inoperable. These splices shall be soldered and waterproofed. The splice insulating package shall be so made as to include all loop leads, loop lead in cable, and lead-in shield as one unit and extend a minimum of 25 millimeters onto the outside jacket of the lead-in cable.
2. Use of a loop lead-in wire other than the approved type.
3. Allowing the contractor to use a sharp instrument, such as a screwdriver, to force loop wire into the sawed slot causing damage to the wire or insulation.
4. Failure to saw loop slots to depths indicated in Standard Plan Drawing J-8A.
5. Failure to clean loop slot of water and dirt prior to placement of loop wire.
6. Failure to hold loops at the bottom of the slots while applying sealant.
7. No other electrical conductors should be installed in the loop detection conduit or junction boxes, without approval.
8. Failure to test loops in the roadways after applying sealant.
9. Use of a tar or asphalt sealer that has been heated so hot that the wire insulation is damaged.
10. Emphasize the importance of the loop detectors installation and testing.
11. Seal conduits with electrical putty or silicone.

Signal Installation

1. When optically programmed traffic signal heads are specified, the inspector should make sure the contractor adjusts the 3M heads according to the manufacturer's recommendation. Some heads have not been programmed by the contractor.
2. The project inspector should check with the Project Engineer when questions arise or substitutions are requested. Do not rely on contractor.
3. Signal Control Equipment:
   A. State furnished — make sure contractor gives schedule of time when he will be ready for installation.

General Information

1. If you do not know how something should be done, don't believe the contractor when he tells you he is doing it right. Contact the Regional Electrical Inspector for guidance and information.
2. Review pole drawings, contract plans, and catalog submittals well in advance of actual work.
3. If you have any questions, contact the Regional Electrical Inspector, Signal Superintendent, or Traffic Section. They will help you.
4. Get a copy of the NEC handbook for ready reference.
5. The RCWs and WACs are on line through the WSDOT Intranet home page if you need additional information from their reference materials. (Some of our specifications make reference to them.)

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Appendix E

Excerpts From RCWs

RCW 19.28.010 Electrical wiring requirements—General—Exceptions.
(1) All wires and equipment, and installations thereof, that convey electric current and installations of equipment to be operated by electric current, in, on, or about buildings or structures, except for telephone, telegraph, radio, and television wires and equipment, and television antenna installations, signal strength amplifiers, and coaxial installations pertaining thereto shall be in strict conformity with this chapter, the statutes of the state of Washington, and the rules issued by the department, and shall be in conformity with approved methods of construction for safety to life and property. All wires and equipment that fall within section 90.2(b)(5) of the National Electrical Code, 1981 edition, are exempt from the requirements of this chapter. The regulations and articles in the National Electrical Code, the national electrical safety code, and other installation and safety regulations approved by the national fire protection association, as modified or supplemented by rules issued by the department in furtherance of safety to life and property under authority hereby granted, shall be prima facie evidence of the approved methods of construction. All materials, devices, appliances, and equipment used in such installations shall be of a type that conforms to applicable standards or be indicated as acceptable by the established standards of any electrical product testing laboratory which is accredited by the department……

RCW 19.28.360 RCW 19.28.210 inapplicable in certain cities and towns, electricity supply agency service areas, and rights of way of state highways.
The provisions of RCW 19.28.210 shall not apply:

(3) Within the rights of way of state highways, provided the state department of transportation maintains and enforces an equal, higher or better standard of construction and of materials, devices, appliances and equipment than is required by RCW 19.28.010 through 19.28.360. [1986 c 156 § 12; 1967 ex.s. c 97 § 1; 1963 c 207 § 4; 1959 c 325 § 3.]

RCW 19.28.510 Certificate of competency required—Electrical training certificate—Fee—Verification and attestation of training hours.

(1) No person may engage in the electrical construction trade without having a current journeyman electrician certificate of competency or a current specialty electrician certificate of competency issued by the department in accordance with this chapter. Electrician certificate of competency specialties include, but are not limited to: Residential, domestic appliances, pump and irrigation, limited energy system, signs, and nonresidential maintenance.

(2) A person who is indentured in an apprenticeship program approved under chapter 49.04 RCW for the electrical construction trade or who is learning the electrical construction trade may work in the electrical construction trade if supervised by a certified journeyman electrician or a certified specialty electrician in that electrician's specialty……

RCW 19.122.020 Definitions. Unless the context clearly requires otherwise, the definitions in this section apply throughout this chapter:

(1) "Business day" means any day other than Saturday, Sunday, or a legal local, state, or federal holiday.

(2) "Damage" includes the substantial weakening of structural or lateral support of an underground facility, penetration, impairment, or destruction of any underground protective coating, housing, or other protective device, or the severance, partial or complete, of any underground facility to the extent that the project owner or the affected utility owner determines that repairs are required.

(3) "Emergency" means any condition constituting a clear and present danger to life or property, or a customer service outage.

(4) "Excavation" means any operation in which earth, rock, or other material on or below the ground is moved or otherwise displaced by any means, except the tilling of soil less than twelve inches in depth for agricultural purposes, or road and ditch maintenance that does not change the original road grade or ditch flowline.

(5) "Excavator" means any person who engages directly in excavation.

(6) "Identified facility" means any underground facility which is indicated in the project plans as being located within the area of proposed excavation.

(7) "Identified but unlocatable underground facility" means an underground facility which has been identified but cannot be located with reasonable accuracy.

(8) "Locatable underground facility" means an underground facility which can be field-marked with reasonable accuracy.

(9) "Marking" means the use of stakes, paint, or other clearly identifiable materials to show the field location of underground facilities, in accordance with the current color code standard of the American public works association. Markings shall include identification letters indicating the specific type of the underground facility.

(10) "Person" means an individual, partnership, franchise holder, association, corporation, a state, a city, a county, or any subdivision or instrumentality of a state, and its employees, agents, or legal representatives.

(11) "Reasonable accuracy" means location within twenty-four inches of the outside dimensions of both sides of an underground facility.

(12) "Underground facility" means any item buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephonic or telegraphic communications, cablevision, electric energy, petroleum products, gas, gaseous vapors, hazardous liquids, or other substances and including but not limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments, and those parts of poles or anchors below ground.

(13) "One-number locator service" means a service through which a person can notify utilities and request field-marking of underground facilities.
[1984 c 144 § 2.]

RCW 19.122.030 Notice of excavation to owners of underground facilities—One-number locator service—Time for notice—Marking of underground facilities—Costs. Before commencing any excavation, the excavator shall provide notice of the scheduled commencement of excavation to all owners of underground facilities through a one- number locator service. All owners of underground facilities within a one-number locator service area shall subscribe to the service. One number locator service rates for cable television companies will be based on the amount of their underground facilities. If no one-number locator service is available, notice shall be provided individually to those owners of underground facilities known to or suspected of having underground facilities within the area of proposed excavation. The notice shall be communicated to the owners of underground facilities not less than two business days or more than ten business days before the scheduled date for commencement of excavation, unless otherwise agreed by the parties. Upon receipt of the notice provided for in this section, the owner of the underground facility shall provide the excavator with reasonably accurate information as to its locatable underground facilities by surface-marking the location of the facilities. If there are identified but unlocatable underground facilities,the owner of such facilities shall provide the excavator with the best available information as to their locations. The owner of the underground facility providing the information shall respond no later than two business days after the receipt of the notice or before the excavation time, at the option of the owner, unless otherwise agreed by the parties.Excavators shall not excavate until all known facilities have been marked. Once marked by the owner of the underground facility, the excavator is responsible for maintaining the markings. Excavators shall have the right to receive compensation from the owner of the underground facility for costs incurred if the owner of the underground facility does not locate its facilities in accordance with this section. The owner of the underground facility shall have the right to receive compensation for costs incurred in responding to excavation notices given less than two business days prior to the excavation from the excavator. An owner of underground facilities is not required to indicate the presence of existing service laterals or appurtenances if the presence of existing service laterals or appurtenances on the site of the construction project can be determined from the presence of other visible facilities, such as buildings, manholes, or meter and junction boxes on or adjacent to the construction site. Emergency excavations are exempt from the time requirements for notification provided in this section. If the excavator, while performing the contract, discovers underground facilities which are not identified the excavator shall cease excavating in the vicinity of the facility and immediately notify the owner or operator of such facilities, or the one-number locator service.
[1988 c 99 § 1; 1984 c 144 § 3.] NOTES: Damages to facilities on state highways: RCW 47.44.150.

RCW 19.122.040 Underground facilities identified in bid or contract—Excavator's duty of reasonable care—Liability for damages—Attorneys' fees.

(2) An excavator shall use reasonable care to avoid damaging underground facilities. An excavator shall:

(a) Determine the precise location of underground facilities which have been marked;

(b) Plan the excavation to avoid damage to or minimize interference with underground facilities in and near the excavation area; and

(c) Provide such support for underground facilities in and near the construction area, including during backfill operations, as may be reasonably necessary for the protection of such facilities.

(3) If an underground facility is damaged and such damage is the consequence of the failure to fulfill an obligation under this chapter, the party failing to perform that obligation shall be liable for any damages.